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A Cart, a box, a GPS: A Luggage cart and a clip style information device design from the view of universal design

Sunyoung Stephanie Kim

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A · CART

A · BOX | A · GPS

**A Luggage Cart and a Clip Style Information Device
Design from the View of Universal Design**

Sunyoung Stephanie Kim

R·I·T

A·CART | A·BOX | A·GPS

**A Luggage Cart and a Clip Style Information Device Design from
the View of Universal Design**

By Sunyoung Stephanie Kim

A thesis submitted to the Graduate School of Imaging Art and Sciences

in Partial Fulfillment of the Requirements for the Degree of

Master of Fine Arts in Industrial Design

School of Design

College of Imaging Art and Sciences

Rochester Institute of Technology

Rochester, NY

March 14, 2013

APPROVAL SHEET

A·CART | A·BOX | A·GPS

A Luggage Cart and a Clip Style Information Device Design from the
View of Universal Design

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ABSTRACT

The existing design of the airport luggage cart, which is intended to help travelers carry multiples pieces of luggage, has some issues. Also, the travelers sometimes are challenged to get information or to communicate with the workers at the airports especially when people travel outside of their mother country. These issues show that the airport needs a new luggage cart that is designed under the aspect of Universal Design. Therefore, this study proposed a new luggage cart design and the possibility of it to provide better service for all.

Keywords: Airport, Luggage, Communication, Information, Universal Design, Luggage cart

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CHAPTER I. BACKGROUND OF STUDY





1. INTRODUCTION TO THE PROBLEM

From 2011 to 2013, I visited various airports, including those in China, Denmark, Japan, South Korea, Taiwan and USA.* I had a range of good and bad airport experiences, traveling through several airports in various countries. During this travelling, I started to think about the possibility that the airport could provide for better service. At the time, I identified two major airport issues, communication and luggage.

First of all, it was hard to communicate with people at the airport to get information, especially in foreign countries. In the summer of 2011, I arrived at the Narita International Airport, Japan, and I had to transfer my flight to go to Seoul. I followed the available signs in the airport, but they seemed to suddenly disappear. I asked for help from a worker in the airport, and was finally able to determine where I needed to go. However, no one was at that location, all the desks were closed, and all the lights were off. I found a security guard and asked for more help. He brought me to another terminal by taking small train that connects two different terminals, but my flight was not there either. Several other people were at the terminal similarly trying to find their flights, and they kept following me to find their way. We asked several people at the airport for help in English, but they did not understand English, or sometimes they seemed to understand what I was saying, but they answered in Japanese, so I could not understand them. Beside, there are even communication problems in airports in one's mother country because so many people pass through the airports every day and waiting lines at information desks are never short.

The second major issue I identified involves luggage. People have to bring their luggage all the time before they board on a flight. They have more difficulties to carry multiple pieces of carry-on luggage since many airlines adopt new strict luggage policy. Almost every airline has adopted policies to decrease the volume (and therefore weight) of checked-in baggage because of the increasing cost of fuel. Before they adopted new baggage policy, the international airlines accept the first two pieces of checked-in baggage for free and domestic flights allow a first piece of luggage without charge. After they adopt new luggage regulation, most international airlines accept a first piece of checked-in baggage for free, but on most domestic flights, travelers have to pay for every checked-in piece. These charges have the effect of encouraging

* US

Greater Rochester International Airport in Rochester, NY; Chicago O'Hare International Airport in Chicago, IL; Philadelphia International Airport in Philadelphia, PA; Hartsfield-Jackson Atlanta International Airport in Atlanta, GA; John F. Kennedy International Airport in New York, NY; LaGuardia Airport in New York, NY; Detroit Metropolitan Wayne County Airport in Wayne, MI.

Other

Incheon International Airport in Incheon, South Korea; Narita International Airport in Narita, Japan; Beijing Capital International Airport in Beijing, China; and Copenhagen Airport in Copenhagen, Denmark; Taipei SongShan Airport in Taipei, Taiwan.

travelers to check in less baggage, but it increases the number, weight and size of carry-on baggage. The number of bags an individual may carry on is limited, but before the airlines adopted the stricter baggage policies, travelers carried on only as much as they needed on board and checked in the bulk of their baggage so there were not as many carry-on items in total. The customers have instead tried to put everything in their carry-on baggage and bring as many as they can since the airlines began charging domestic travelers for the first check-in bag. Because of these changes, the number and weight of the luggage which people carry as they move through the airport is increased.

Besides of these two major issues, there are more issues that people having difficulties at the airport. This study will focus on more issues at Chapter V. Among all the issues this study was started to solve the major issues, which are the communication or getting information and moving one's luggage.

2. PURPOSE OF THE STUDY

The flights let people travel to the foreign countries, which they never imagined doing before the invention of an airplane. When people used to travel over the ocean, it took them several days or months to arrive. Now, they can travel to anywhere within a day by taking a flight. The airport became a hub of connecting all the countries, allowing people to go to another country more easily. Thus, the airport is the place that people leave one country and are welcomed to another country. Now, more and more various people will use the airport, however, the current airports have some difficulties to provide adequate service to many of various people.

I choose the luggage cart as a method to solve some controversial issues at the airport, and I will suggest the future and possibility for the luggage cart. The current luggage cart is used only for moving baggage, but I saw the potentials and the problems of it. So I will share what the problems and the solutions are in this study. If the airports can solve the current problems and offer better service, then they can save money and potentially gain profits. A luggage cart is designed for the convenience to move personal luggage at the airport. It helps people to move several pieces of baggage at the same time, but people are sometimes having difficulties in using it. Usually, the luggage cart is generally designed for people who are statistically normalized in several categories, such as age, nationalities, and gender (hereinafter the Users). However, I was interested in the outliers who do not belong to the Users and need some help. I tried to research their needs to design a luggage cart for all. I believe that considering their needs will not only satisfy them and include them into the user group, but also it will provide better service than now to most of the other people. This approach is similar to the point of view of Universal Design. Universal Design is a design theory under which a place, object, or system is designed for as many people as possible. It is important to design a luggage cart under Universal Design theory because so many different types of people will use it at the airport. I studied and analyzed several products following the concepts of Universal Design to design a luggage cart in this point of view.

There are two basic benefits from a luggage cart designed under Universal Design aspect. First of all, it can increase the number of users.

A luggage cart designed under Universal Design can add outliers to the User group, solving the issues for them. As I mentioned before, the current luggage cart is designed for the Users, and the outliers may need help from the Users or workers in the airport. Because of this reason, the outliers may feel not comfortable to visit the airport. This study believe the luggage cart designed under Universal Design will help outliers and most of people to use the airport and provide improved experience to them.

Secondly, the service improvement for a luggage cart designed under Universal Design, will save unnecessary expense and make profits. The current luggage cart is managed in inefficient way. Thus, the airport spends unnecessary expense to keep the current service because they have no alternative service solution. The new designed luggage cart will save this unnecessary expense and even may make profits with improved service. Therefore, the airport can have more customers and their satisfaction will make a better brand-image, creating a virtuous cycle. Thus, there are many benefits that the airport can have by providing better service

CHAPTER II. THE UNIVERSAL DESIGN

“ Universal Design is a design or ‘design for all’ that promotes social justice since it provides users and benefits even

has been termed inclusive
'all' and this implies equity and
considers the needs of all
everyone”

1. THE UNIVERSAL DESIGN

As mentioned on the previous chapter, the airport can get many benefits by providing a luggage cart that designed under Universal Design aspect. This chapter studied the Universal Design and analyzed several products from the aspect of Universal Design. It will show the benefits of Universal Design and prove the reason why the luggage cart needs to be designed under this aspect. Technological development causes the extension of lifespan. Because of this, the number of seniors in the world rapidly increases in developed countries, in America (chart 1). At the same time, this industrialization creates diverse industrial accidents, causing the increase of the number of people who are physically and mentally challenged is increasing (for more information, visit the Bureau of Labor Statistics).

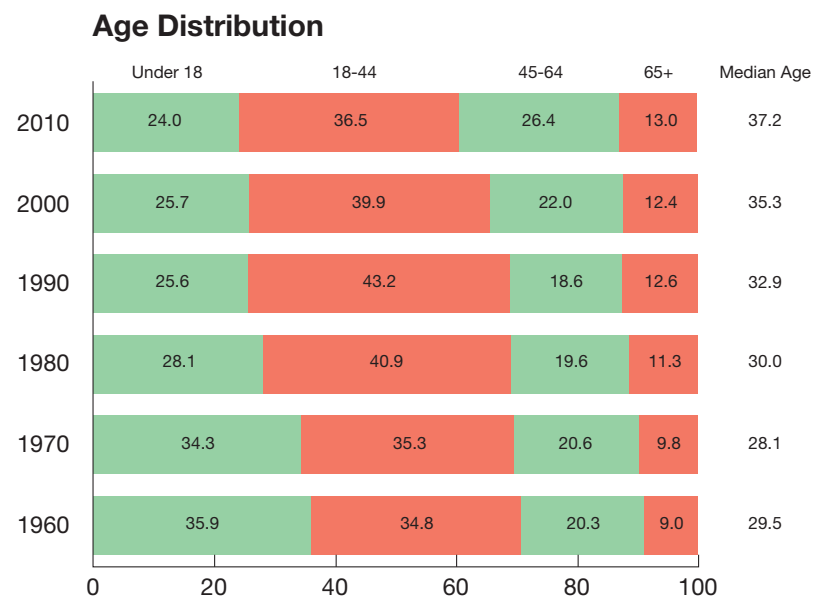


Chart 1. Age Distribution

Following the research conducted by International Labor Organization, the 19% of the main cause of death at work is the accident in worldwide. This is the third biggest number after the number of death caused by cancer and circulatory (chart 2). This research not only shows that the accidents at work is the third main cause of death, but also provides an assumption that many people may suffer the injury from the accidents at work. Now, we need to consider their, mentally or physically challenged people, social and/or economical needs.

To help the outliers, less-abled people, the new concept was created which are the Barrier-free Design and Accessible Design. The Barrier-free Design first came out in the 1950's, people used it to design

Main Causes of Occupational Fatalities Worldwide

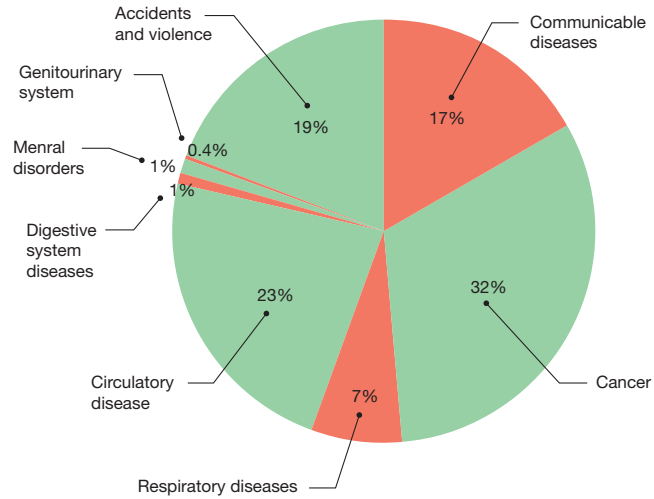


Chart 2. Main Causes of Occupational Fatalities Worldwide

facilities or surroundings that can be used by less-abled people without any difficulties, so that they can use it more comfortably. This design concept, however, needs special facilities for senior or disabled people, so this concept causes spending a lot of money and promoting an atmosphere of social disharmony. Therefore, senior and/or disabled people feel uncomfortable when they use Barrier-free Design facilities.

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Ronald Mace first used a term, Universal Design, to solve the issues that mentioned above in 1985. He started the Universal Design movement as a design approach that guarantees products can be used by almost everyone to overcome the limits of Barrier-free Design and Accessible Design. The Center for Universal Design explained that although accessibility for the less-abled is the pedestal of Universal Design, the terms Universal Design, Accessible Design or Barrier-free Design is not similar. They further states that “Universal Design has been termed inclusive design or ‘design for all’ and this implies equity and social justice since it considers the needs of all users and benefits everyone” and advocates that designs should be for all people to the greatest extent possible, without special adaptation or modification. (The Center for Universal Design, 2008)

Universal Design means considering everyone not only general people, but also the people who need help because of their physical or psychological ability when designing a product, facility or a service. Thus, this approach can save money because people do not have

to spend extra money to make a product, facility, or service just for the outliers. By doing this, it can prevent the outliers from a sense of alienation. This kind of bottom-up approach to design requires designs that recognize the needs of all users, instead of using a top-down design that only includes enumerated prescription.

The definition of Universal Design as design for all, distinguishes it from related terms such as Accessible Design or Barrier-free Design. The terms are similar, but have subtle differences that are important. Universal Design strives to design products that are usable by all people to the greatest extent possible. Accessible Design, however, meets the needs of a special user and Barrier-free design meet the needs of a selected user with specially designed product.





	Barrier-free Design	Accessible Design	Universal Design
Definition	The design of specialized products to meet the needs of a selected segment of the total user population.	The design for special user to meet their needs to support their lack ability by considering the usability, safety, and convenience.	The design to be usable by all people to the greatest extent possible, without the need for adaptation of specialized design.
Examples	 <p>Figure 1. Disability building ramp</p>  <p>Figure 2. Disability automatic door</p>	 <p>Figure 3. Walker</p>	 <p>Figure 4. Touch20</p>

Table 1. Definition of design concepts Barrier-free Design, Accessible Design, Adaptive Design, and Universal Design

2. SEVEN PRINCIPLES OF THE UNIVERSAL DESIGN

There are seven principles of the Universal Design to know to design a product in that point of view. The Center for Universal Design describes the concept of Universal Design as proposing designs to be usable by all people, to the greatest extent possible, without special adaptation or modification (2008). Universal Design began as a movement in architectural design in 1985 to address accessibility in housing. However, during the past twenty years, the Universal Design approach is practiced in such fields as product design, urban design and civic engineering, landscape design, information technology, telecommunications, and education. (Anne Gupthill, 2011)

The principles of Universal Design have expanded from concerns about legislated accessibility guidelines that address only the special needs of a few, to an inclusive design process that benefits everyone. Universal Design is an integrated and holistic approach to design, of which the seven principles listed in Table 2 promote equitable use, flexibility in use, simple and intuitive, perceptible information tolerance for error, low physical effort, and appropriate size and space for approach and use when designing products or environments (The Center for Universal Design, 2008). Again, the concept of Universal Design is different from Accessible Design, although accessibility is the foundation of Universal Design.

Principle	Definition and Guidelines for Use
Equitable use	<p>The design is useful and marketable to people with diverse abilities.</p> <ul style="list-style-type: none"> - Provide the same means of use for all users: identical whenever possible; equivalent when not. - Avoid segregating or stigmatizing any users. - Provisions for privacy, security, and safety should be equally available to all users. - Make the design appealing to all users.
Flexibility in use	<p>The design accommodates a wide range of individual preference and abilities.</p> <ul style="list-style-type: none"> - Provide choice in methods of use. - Accommodates right- or left-handed access and use. - Facilitate the user's accuracy and precision. - Provide adaptability to the user's pace.
Low physical effort	<p>The design can be used efficiently and comfortably and with a minimum of fatigue.</p> <ul style="list-style-type: none"> - Allow user to maintain a neutral body position. - Use reasonable operating forces. - Minimize repetitive actions. - Minimize sustained physical effort.
Simple and Intuitive use	<p>Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.</p> <ul style="list-style-type: none"> - Eliminate unnecessary complexity. - Be consistent with user expectations and intuition. - Accommodate a wide range of literacy and language skill. - Arrange information consistent with its importance. - Provide effective prompting and feedback during and after task completion.
Perceptible Information	<p>The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.</p> <ul style="list-style-type: none"> - Use different models (pictorial, verbal, tactile) for redundant presentation of essential information. - Provide adequate contrast between essential information and its surroundings. - Maximize "legibility" of essential information. - Differentiate elements in ways that can be described. (i.e., make it easy to give instructions or directions). - Provide compatibility with a variety of techniques or devices used by people with sensory limitations.
Tolerance for error	<p>The design minimizes hazards and the adverse consequences of accidental or unintended actions.</p> <ul style="list-style-type: none"> - Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded. - Provide fail-safe features. - Discourage unconscious action in task that requires vigilance.
Size and space for approach and use	<p>Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.</p> <ul style="list-style-type: none"> - Provide a clear line of sight to important elements for any seated or standing user. - Make reach to all components comfortable for any seated or standing user. - Accommodate variations in hand and grip size. - Provide adequate space for the use of assistive devices or personal assistance.

Table 2. Seven Principles of Universal Design

3. THE EXAMPLES OF THE UNIVERSAL DESIGN

This section will analyze several products in the concept of Universal Design so that we can see what makes the product as Universal Designed product and show how the major companies design a product for everyone. This research will shows the benefits of products that designed under the aspect of Universal Design and teach the way to achieve it.

3-1. Good Grip, OXO

Sam Farber, an entrepreneur in the housewares industry, notices that his wife Betsey was having difficulty gripping ordinary kitchen tools due to a slight case of arthritis in her hands. He asks to himself why do ordinary kitchen tools hurt your hands? Why cannot there be wonderfully comfortable tools that are easy to use? He saw an opportunity to create more comfortable cooking tools that would benefit all users.

Sam came out of retirement and approached the design firm Smart Design with that challenge. As part of the initial research that included talking with consumers, chefs and retailers, Patricia Moore, a noted gerontologist, was brought on board to help understand the needs of users with special needs.

After hundreds of models, dozens of design iterations, and extensive research, OXO was born. In 1990, the first group of 15 OXO Good Grips kitchen tools was introduced to the U.S. market (figure 5 to 9). These ergonomically designed, trans-generational tools set a new standard for the industry and raised the bar of consumer expectation for comfort and performance. (OXO, 2013)

Figure 5. 11" Balloon Whisk
Figure 6. Egg Beater



Figure 7. Pro Y Peeler
Figure 8. Angled Measuring Cup for 1 Cup



Figure 9. Five Piece Nylon Tools Set



Table 3. Analysis of OXO Good Grip with the Seven Principles

Principle	Analysis
Equitable use	OXO did an intensive research with various people to design Good Grip. This product can be used by almost everyone with same means by gripping them easily. OXO uses a new material named Santoprene so that they can increase the durability of their products. By using the material, it is soft to the touch and easy to grip. This feature helps OXO to build up their own identity as a company that designs ergonomic kitchen tools.
Flexibility in use	OXO designs a soft handle like a fish fin to accommodates right or left hand people, so that the handle can be more flexible when people grip it.
Low physical effort	It minimizes the physical effort to use kitchen tool by upgrading the design and the material.
Simple and Intuitive use	When OXO designs, they study about kitchen tools with physically challenged people to design a product that helps those users to easy to use. By doing this, they wanted to produce a set of kitchen tools that can be easily used by all people. All the Good Grip products designed for all users, but it still have its conception as kitchen tools.
Perceptible Information	The design is simple and requires only basic tasks, so the users can easily figure out how to use and be adapted it.
Tolerance for error	OXO minimized the risks of the users when they are using it with high durability and ergonomic design.
Size and space for approach and use	It designed by extensive research and test, so the size and design is fit for many people. It is easy to grip, and easy to use.

3-2. Action Office, Herman Miller

Herman Miller is an American furniture company and was founded by D. J. Depree, in Zeeland, Michigan in 1923. Herman Miller adapted a module system to design an office, and developed 'Action Office System' for designing an open space (figure 10 and 11). The company marked a new era in the industry. The 'Action Office' designed as panel system furniture and suggested new ideal space design for the office space. People can hide all the electronic lines under the furniture system and add furniture to panel to create personal or public area. This analysis of table 4 is based on the general function and characteristics of Action Office, which includes panel, working storage, and movable table, under the Seven Principles of Universal Design.

Figure 10. Action Office Series 2 120-Degree Configuration with Thin Base



Figure 11. Action Office Series 2 120-Degree Configuration, Open/Collaborative Environment



Principle	Analysis
Equitable use	People can set up shelves over the head or under/ beside the table to meet their needs. Also, the height of a table or the height of a keyboard shelf can be easily adjusted by users.
Flexibility in use	The side table can be added anytime when people need it for the extra work or resting. The partition can also be easily added to create varied space depending on the purpose. The strength of light for the personal workspace can be easily adjusted, and people can adjust the height of each wall of cubicles, depending on their purpose of working to comfortably communicate with their colleagues.
Low physical effort	It has multiple choices to create the storage space. Plus, the wiring system inside of panel is well organized. Thus, people can easily use the Action Office system after it adjusted to them without big challenges.
Simple and Intuitive use	Depending on the purpose of its usage, Action Office can create various types of space such as private space or open space.
Perceptible Information	The height of worktable can be adjusted, so that the users can use it by standing or sitting in front of it. It has a movable table that can be used as temporary table for unexpected meeting or for extra work.
Tolerance for error	The corner was finished with rubber or leather for safety and the purpose of preventing the belongings of a user from falling down from the worktable.
Size and space for approach and use	The user can adjust the workspace by rotating the worktable from 90 degree to 120 degree to provide most comfortable position for almost every user for any purpose.

Table 4. Analysis of Herman Miller 'Action Office' with the Seven Principles

3-3. Aeron Chair, Herman Miller

Herman Miller uses Pellicle Suspension that is a net system, which helps air circulation, and made with new material to make Aeron Chair (figure 12 and 13). The new material keeps the temperature evenly, so people will not sweat while sitting on this chair. By distributing the weight to the seat and the back evenly, people can sit on it with proper posture. It comes produces with three different sizes for different types of people (figure 14). Herman Miller creates PostureFit system which is an ergonomic development to keep proper sitting posture by creating the back support in accordance with spine and eliminating the gap between the under the belt-line and the back (figure 15 and 16).

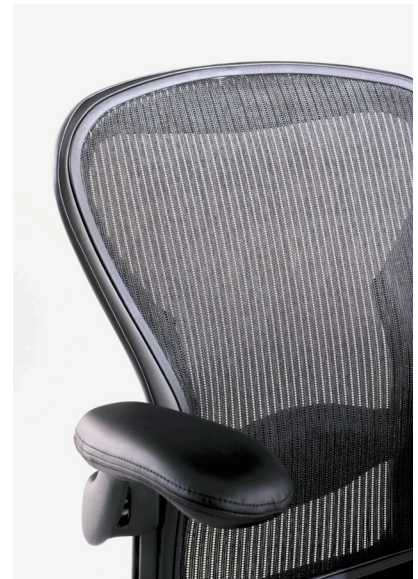


Figure 12. Aeron Chair
Figure 13. Pellicle Suspension



Figure 14. Aeron Chair Family (Side Chair,
Work Stool, Work Chair)

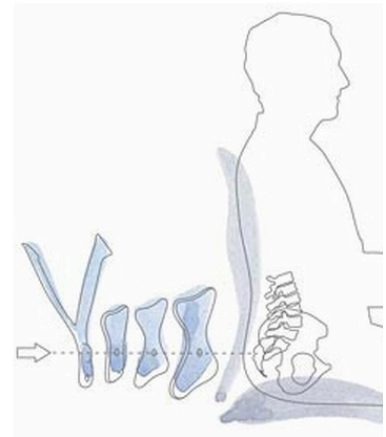


Figure 15. PostureFit
Figure 16. PostureFit Drawings



Figure 17. Aeron Tilt Adjustment and Tilt Limiters Levers
Figure 18. Aeron Arm-Height Adjustment Lever

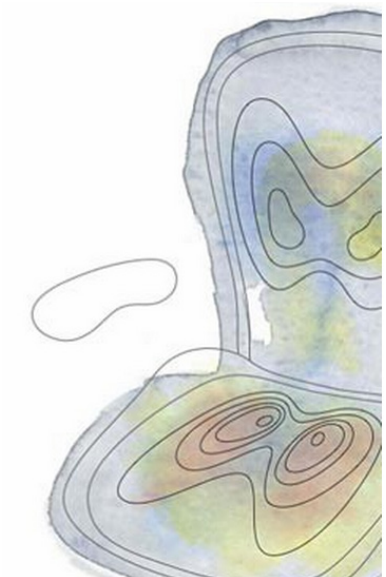


Figure 19. Aeron Arm-Angle Adjustment
Figure 20. Pressure Mapping and Thermal Testing

Principle	Analysis
Equitable use	This chair comes with three different types, so people can choose it depending on their needs. The height can also be adjusted up to 15cm.
Flexibility in use	The users can adjust the angle of the back and recline it, so that they can use it as a multi-functional chair (Figure 18). When the users change the angle of the chair, they can fasten it, allowing people to use this chair for various purposes. Also, the armrest can be easily adjusted with different height or angle (Figure 19 and 20).
Low physical effort	Herman Miller uses Kinematic tilt function, which provide stability and comfortable feeling to user. It allows people to move their ankle, knee or move the chair around the table easily when they sit on.
Simple and Intuitive use	The way to adjust height is easy. People can do it by lifting the paddle lever.
Perceptible Information	This chair has a special function called as 'typing mode'. When the user needs to focus on their works, the function allows them to lean their body forward. In addition to such function, this chair also has other various functions; such as the height adjustment control and the height and angle of armrest adjustment to allow people to do several different tasks.
Tolerance for error	By allowing people to modify the detail settings, it minimized the chance of accidents.
Size and space for approach and use	All adjustment handles are located within hand-reaching distance, so people can easily have access to it. The Herman Miller research team did pressure mapping and thermal testing to study the weight distribution and heat and moisture dissipating qualities of the Pellicle material on the Aeron Chair's seat and back. The research team found that of all the anthropometric dimensions measured, height and weight had the strong relationship to chair size preference. The relationship is strong enough to decide to make one of the three chair sizes based on those dimensions (Figure 15 and 21).

Table 5. Analysis of Herman Miller 'Aeron chair' with the Seven Principles

3-4. Mirra Chair, Herman Miller



Figure 21. Mirra Chair

Figure 22. TriFlex and Aireweave Suspension

* TriFlex

This is a new system designed to keep the back in a multitude of ways; lumbar, lower spine, shoulders.

** Passive PostureFit

The Passive PostureFit designed to support the lower spine of a user, the part of his back below the belt, and to do it without forcing the user into an uncomfortable or unsustainable position. Research has shown that most office workers sit forward in their seat when they work, slouching. Camber contour at the base of the back makes it comfortable and natural to assume the user's normal position at work, and at the same time relieves all the stress and unhealthy alignments and tensions from their back. (Smart Furniture, 2013)

The Mirra chair uses TriFlex* system on their back (figure 21 and 22). Therefore, it gives comfortable feeling and can be used by all different types of people. It is easy to control with high functionality. The up-down movement allows people to move their ankles, and knee comfortably without any difficulties. Also it helps people to sit and remain seated with balanced posture. The Mirra chair intended to design a single-sized chair that would fit the size requirements of 95 percent of the population. (Yeon-sook Lee, 2004 p. 153)

In addition, this spine-shaped back support system called TriFlex has a simple, yet effective support system, by which the chair supports the back and spine of the users with various body shapes, postures, and habits of movements. Herman Miller upgraded PostureFit used in Aeron chair to Passive PostureFit** (figure 23). The new version is designed to make people to seat on this chair with a correct spine alignment by supporting your lower spine, the part of your back below the belt, and to do it without forcing you into an uncomfortable or unsustainable position. Also the back has a net system, allowing air circulation.

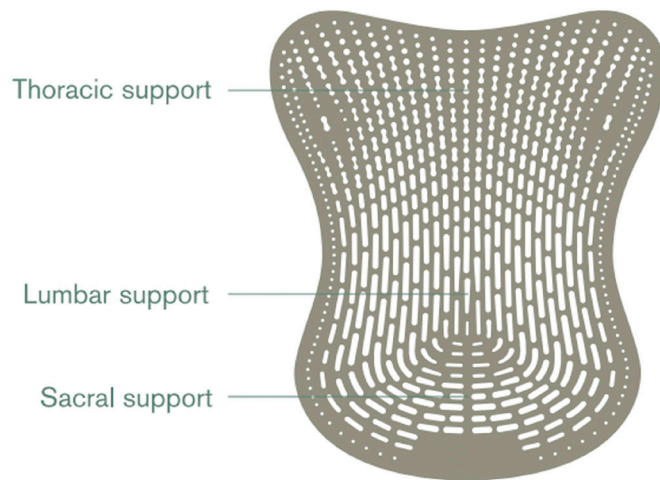


Figure 23. Passive PostureFit

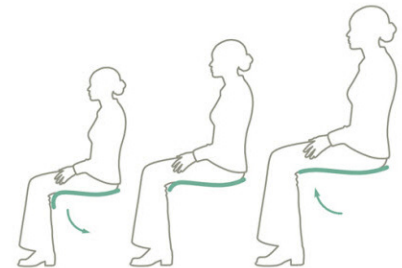


Figure 24. FlexFront
Figure 25. FlexFront-1

Principle	Analysis
Equitable use	A FlexFront seat, so the user can adjust the size of the front seat by moving back and forth within the range of 4 inches (Figure 24 and 25). This can make a difference by covering people's various body sizes and preventing to have a gap between the front seat and back support. The height can also be controlled up to 12cm.
Flexibility in use	The user can lean forward to focus on their work. This chair supports 5 different postures so that the user can do various works on this chair.
Low physical effort	It requires simple task to control the function of the Mirra chair, so everyone can adjust it easily.
Simple and Intuitive use	The operation system is very similar to the other chairs of Herman Millar. The users already used to the means of its adjustment. Also this controlling system of Mirra Chair is consisted with the function itself. Therefore, the user can easily learn how to control it while they seat on the Mirra chair even without reading the manual.
Perceptible Information	All of each function is designed for the user so that they can easily use.
Tolerance for error	The Mirra chair can be used in several different situations, and minimize a chance of accident.
Size and space for approach and use	The Mirra chair has multiple choices to adjust its shape to fit to the user by controlling the height or resizing the seat.

Table 6. Analysis of Herman Miller 'Mirra chair' with the Seven Principles

3-5. Low-floor Bus

A low-floor bus eliminated steps between the sidewalk and entrance of the bus by making the floor the same height as the sidewalk (figure 26). The passenger can take the bus more easily by improving the height difference that causes problems before the introduction of a low-floor bus. This bus designed not only for the general passengers, but also for the elderly and less-abled people, including passengers who use wheelchairs. A low-floor bus is not the first designed bus for the people who need help. However, previous solutions to assist such people were either the bus with a lift being raised by electricity or the bus with the low-floor only for specific part of the bus (figure 27 and 28).

As mentioned above, this kind of treatment can cause isolated feeling, so the passengers required to use these entrances are likely to avoid ride the bus. The low-floor bus suggested as a solution to clear this problem, and encourage more passengers to use public transportation without any difficulties. This bus achieves a low floor height by locating the engine in rear and by moving the front wheel in front of the entrance. A low-floor bus clearly shows the advantage of Universal Design. People can obviously see the difference with previous bus, and the intention of the design is similar with the aspect of Universal Design. Currently, many countries such as United Kingdom, India, Australia, Japan and South Korea serve this type of buses as a public transportation, and the usage rate of this bus is increasing in these countries. Plus, more countries are adopting this type of buses.



Figure 26. A Low Floor bus in use by the
Bloomington-Normal Public Transit
System

Figure 27. Accessibility Example of Bus
Figure 28. TARPS



Table 7. Analysis of the Low-floor Bus with the Seven Principles

Principle	Analysis
Equitable use	Various people can use a low-floor bus without using special equipment, and they can ride a low-floor bus more easily.
Flexibility in use	A low-floor bus is designed to solve some of previous problems in buses; so more people can use it easily not even people on wheel chair.
Low physical effort	It requires simple task to control the function of the Mirra chair, so everyone can adjust it easily.
Simple and Intuitive use	The previous design has the height difference causing many accidents and requiring attention when people take the bus. However, a low-floor bus solves this problem by making a floor lower paralleled to the height of the sidewalk.
Perceptible Information	Learning new information is not required.
Tolerance for error	There is a possibility for the accident because a gap between the sidewalk and the floor of the bus still exists. However, a low-floor bus deceases the chance of the accident. Also, less-abled people or elderly can take the bus without using special method that causes to feel the sense of prejudice. Thus, now they feel more comfortable to take a bus.
Size and space for approach and use	All public transportation is used by all range of age, sex and nationality. Therefore, the designer focused on the size and function of the bus when designing a low-floor bus.

CHAPTER III. THE LUGGAGE CART





1. THE HISTORY AND TYPES OF THE CART

This chapter studied the origin, function, and the different types of the cart that basically devised to move the loads. This study is important to design a luggage cart with the problem that driven from moving luggage at the airport. The origin of luggage cart can be considered when the wheel was invented. This section researches about the history of luggage cart from the invention of the wheel because the wheel is the most crucial part to design a cart. Human invented the wheel, and wheel is not something that can be founded in nature. The creation of the wheel has been credited to the Elamites because their art works show and describe the wheels for the earliest time. However, there is a possibility that people had used the wheel before the written history. People had used to move a load by putting it on the back of animals or move it by themselves before the invention of the wheel (figure 29 and 30). Although it may seem surprisingly now, the means of moving a load with animals by using the wheel took quite a long time to be discovered. During the time before the invention of the wheel, people used to put carriers without the wheel, such as a sled, lashed onto the back of animals to move the load. Hence the reason, the carrier that used in that time looked like a sled (figure 31 and 32). Subsequently after, people found out that they could easily move the load by putting it on a board and placing a set of logs, underneath the board, by which people could roll it forward (figure 33). People invented the wheels by developing the usage of rollers and making improvements on the use of the rollers (figure 34, 35 and 36). After the invention of the wheel, people could move more loads with less energy. Furthermore, people started to design a carrier with two wheels to put it on the back of animals (figure 37, 38 and 39). Finally, they could move the load with more weight, and eventually have created a chariot or wagon that people can ride with the carriers lashed on to animals. In summary, the invention of the wheel has made humans to move heavy load more quickly and easily, and it allow us to create better transportation device, such as automobiles or bicycles. (Edwin Tunis, 1955)

Now, along with other transportation device, people use a cart everywhere. They use it in many different places such as a market, airport, post office, factory and so on. Basically, most of the current carts are moved by pushing them forward and people have to hold the handle. However, the design and the function of the cart are different

Figure 29. Pack Animal Drawing
Figure 30. Pack Animals Picture



Figure 31. Pawnee Indian Travois
Figure 32. Primitive Sledge

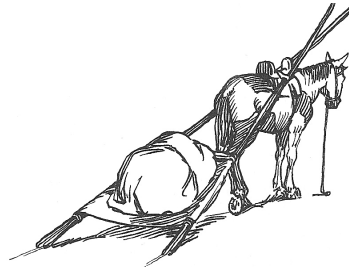


Figure 33. Sledge on Capative Roller
Figure 34. Grooved Roller

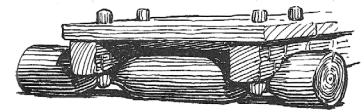
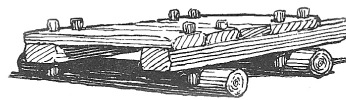


Figure 35. Solid "Wheel" with Rotating Axle

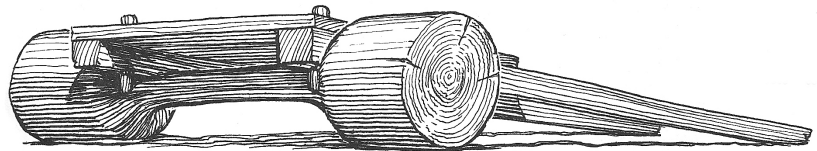


Figure 36. Solid Wheels on Fixed Axle
Figure 37. Mexican Cart with Built-up Solid Wheels

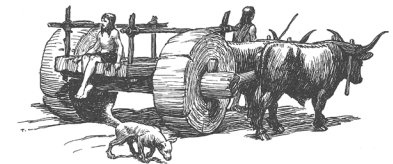
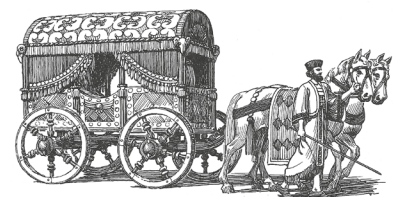
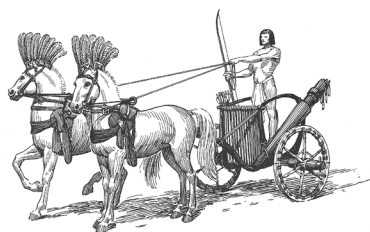


Figure 38. Egyption Hunting Chariot, about 1500 B.C.
Figure 39. Persian Harmanaxa or Women's Wagon, about 450 B.C.



depending on the purpose and the location that are being used. For instance, the cart that is used in the grocery store looks like a big basket with four wheels. It was designed to help customers to move around with a lot of groceries (figure 40, 41 and 42). There are two main reasons that the shopping cart made with thin metal bars instead of using thick metal tube like a material that used on a luggage cart at the airport. The first reason is that it is designed for housewives because they are the most users, and other reason is that the groceries are usually not heavy as a luggage, so it does not need to use thick metal tube like a luggage cart at the airport. Plus, the shopping cart has a seat for child, so mothers can go grocery shopping with their children without worries. People can easily walk around to find what they want at the market with



Figure 40. GC-R-155L
Figure 41. Plastic Shopping Carts



Figure 42. EXpress6000

this cart because of its lightness. If it was heavier than it is, then it may be safer to use, but it would get many complaints from the users by making them more tired.

Another place using the cart is the post office. The post office uses several different types carts to sort out and deliver all the mails or parcels. When the post officers move big packages, they generally use a trolley (flatbed pushcart or hand truck), which is known as a cart that moves heavy and many things at once. It has a handle on the back or both front and back with a flat base (figure 43, 44, 45 and 46). Also, the post officers use a small cart that has a pocket to deliver mails (figure 47 and 48).



Figure 43. Brüder Mannesmann
Figure 44. Service trolley



Figure 45. Mesh Flatbed Platform Truck
Figure 46. Harper Standard Composite Hand Truck



Figure 47. USPS Mail Carrier 1



Figure 48. USPS Mail Carrier 2

When people want to move heavy objects, they use a special cart, pallet jack or pallet truck (figure 49). The pallet jack (pallet truck) was invented to move heavier cargo more easily in such place like a factory. This looks different from original cart shape, but it is designed by following the basic concept of the cart. It can be regarded as an upgraded version of a cart to lift and carry heavier things. It has a motor and batteries to use electricity to carry the load instead of using manpower only. It runs with electricity, so people do not have to spend their energy to move it. However, sometimes moving things with a cart by manpower can be considered as the most efficient and safe way to do it because the pallet jack needs time to be charged with electricity. Also, people have to be more careful to it when they use it, if not it may cause more accidents

when people use it carelessly. Therefore, choosing a type of carts will depend on the circumstance and purpose.

Lastly, the luggage cart at the airport is designed to help patrons to move several of their belongings such as luggage or a set of golf club at once (figure 50). Each luggage has wheels on it, but people usually have trouble carrying more than two luggage at the same time. There are more types of carts, but the luggage cart in the airport is focused in this study.



Figure 49. Pallet truck



Figure 50. Caddie Baggage Trolley

2. THE LUGGAGE CART

This section analyzes the luggage cart with the seven principles of the Universal Design and researched the proper function and usage of the luggage cart so that this study can suggest better idea for people. From this analysis, this study can suggest a way to improve current luggage cart. The luggage cart referred to the cart that is generally used in the airport (figure 51). Many different carts are being used at the different airports. In this study, however, I limit the range of it to a cart, which the patrons use it at the airport by themselves. The luggage cart is designed to easily move several pieces of baggage, combined. It is generally made with the metal tube and has a seat for a child or a small basket in front of the handle. The handle requires people to push downward to move the luggage cart for the safety reason. Otherwise, it will not move. People put their small belongings such as handbag or backpack in the child seat or a small basket. Some airport have a luggage cart that has a front block, which is located in front of the loading base so that it protects the luggage from falling down. It is generally known that the family travelers use the luggage cart more than the single travelers because of the number of the luggage. Before the service of the luggage cart, the parents have to take their children with one hand and handle their luggage with other. After the creation of the luggage cart, however, they can use both hand by putting their kids on the luggage cart. Otherwise, they can put several pieces of luggage on a cart and handle a luggage cart with a hand and hold their children's hand with other hand.

Despite many benefits of the luggage cart, it still has several issues. First of all, it has safety problems. It is hard to maneuver, so sometimes people unexpectedly hit another with a luggage cart. Secondly, the handle is designed to prevent unintentional accident, but it requires certain strength to use it, so people can get easily tired. Lastly, people are generally not accustomed to use the airports because people may only visit airports when they are on a business or personal travels. Therefore, people may have a hard time to find a luggage cart at the airport, and they just decide to move their luggage without it even if they get more tired. These major issues are the reason why this study decided to study about the luggage cart.



Figure 51. Smart Carte

Principle	Analysis
Equitable use	The luggage cart designed to provide a moving service to people, but some people may not be able to use it.
Flexibility in use	A luggage cart can be used by right or left handed people without any difficulties. However, people may not be able to bring the luggage cart to the some places such as a restroom.
Low physical effort	Some current luggage carts require physical effort because people have to push it to downward and push it to forward at the same time to move the luggage cart.
Simple and Intuitive use	For the case of the luggage cart that can be only used when people push the handle downward, people may not used to it, but mostly the luggage cart has an instruction on its handle.
Perceptible Information	People can easily see the usage of the luggage cart from its appearance.
Tolerance for error	Some of the current luggage cart only move when the user push its handle down. This operating system prevents possible accident when the cart moves unexpectedly.
Size and space for approach and use	Sometimes, the airport provides two different sizes of luggage cart, so that user can choose. However, the user may not see the in front of the luggage cart clearly when they have several pieces of luggage on it.

Table 8. Analysis of a Luggage Cart with the Seven Principles

3. CURRENT CONDITION AND TENDENCY IN USING THE LUGGAGE CART

This section shows the current condition of the luggage cart at the airport and focus on user's tendency in using the cart. Researching the need and issues in using luggage cart is very important to design a better luggage cart. I observed a very interesting effect as I traveled through China, Denmark, Japan, South Korea, Taiwan and USA. Most of people use luggage cart at the airport when they move their luggage after arriving at the airport from drop-off / pick up area or parking lot to the check-in desk inside of the airport. The airports that providing the luggage cart before and after the security check cost more than the one that is not providing in both areas. Therefore, the small airport that only has domestic airlines usually serve the luggage cart only before the security zone because the airport has to consider the cost efficiency. Also, mostly the domestic travelers do not have many items compared to the international travelers, so they do not need to use a luggage cart. Some international airports even serve the luggage cart both before and after security check, especially when they have duty-free shops after the security zone. While I research the several airports in the world, I realize that every airport has different design of luggage cart, and the users' tendency appears to be quite different.**



Figure 52. Beijing Capital International airport,
Beijing, China
June 10, 2006
(Inside of security area)

Figure 53. Beijing Capital International airport,
Beijing, China
June 10, 2006
(Outside of security area)



Figure 54. Incheon International airport,
Incheon, Korea
August 2, 2010
(Outside of security area)



Figure 55. Narita International airport, Narita,
Japan
June 10, 2011
(Outside of security area)





Figure 56. Chicago O'Hare International airport, Chicago, IL, USA
December 16, 2011
(Inside of security area)



Figure 57. Chicago O'Hare International airport, Chicago, IL, USA
December 16, 2011
(Inside of security area)



Figure 58. Chicago O'Hare International airport, Chicago, IL, USA
December 16, 2011
(Inside of security area)

Figure 59. Chicago O'Hare International airport, Chicago, IL, USA
December 16, 2011
(Inside of security area)



Figure 60. Philadelphia International airport, Philadelphia, PA, USA
January 16, 2012
(Outside of security area)



Figure 61. Philadelphia International airport, Philadelphia, PA, USA
January 16, 2012
(Outside of security area)



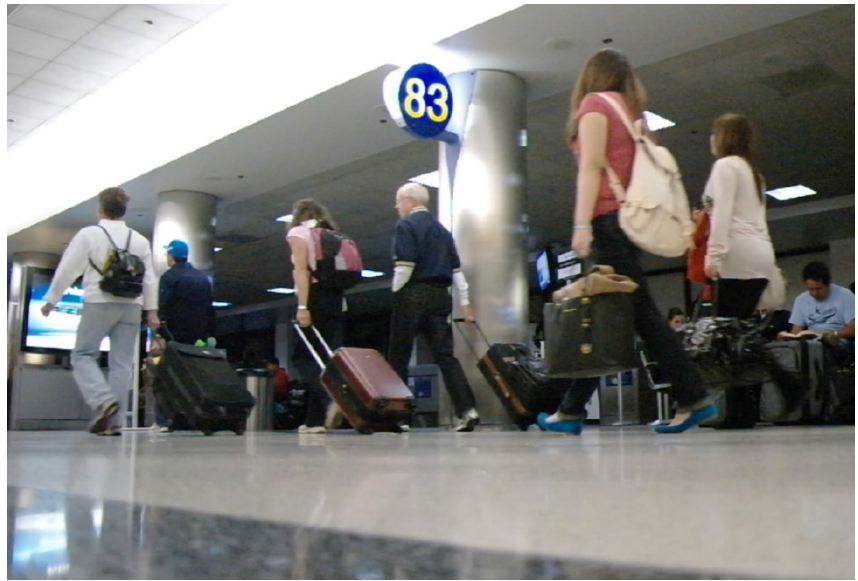


Figure 62. Philadelphia International airport,
Philadelphia, PA, USA
January 16, 2012
(Inside of security area)



Figure 63. Narita International airport, Narita,
Japan
April 1, 2012
(Outside of security area)



Figure 64. Incheon International airport,
Incheon, Korea
January 8, 2013
(Outside of security area)

Figure 65. Incheon International airport, Incheon, Korea
January 8, 2013
(Inside of security area)



Figure 66. Taipei SongShan airport, Taipei, Taiwan
January 8, 2013
(Inside of security area. In front of the gate)



Figure 67. Taipei SongShan airport, Taipei, Taiwan
January 8, 2013
(Inside of security area. In front of the baggage claim)



Figure 68. Incheon International airport,
Incheon, Korea
January 16, 2013
(Inside of security area)



Figure 69. Detroit Metropolitan Wayne County
Airport, Wayne, MI, USA
January 16, 2013
(Inside of security area. In front of
the baggage claim)



Figure 70. Airside Baggage Cart
Figure 71. Airport Baggage VariCart

First of all, a tendency to use a luggage cart depends on the locale. Travelers in Asia (China, Japan, South Korea and Taiwan) and in Europe (England, France and Denmark) frequently use luggage carts. Also, Asian and European airports use the luggage cart before and after the security check. They even offer two different size of luggage cart, so travelers can select a cart scaled to their needs (figure 52 and 53). However, the airports generally provide the luggage cart only before the security check and far fewer travelers use luggage carts in America. Plus, I learned that the cost of using a luggage cart is cheaper in Asia and Europe than in America, and, in some places from my brief observation, luggage carts are available for free.

Plus, the number of the luggage cart usage depends on the size of the airport. Moving through the airport with several pieces of luggage makes people really tired and agitated, so people preferred to use the luggage cart if they are in a huge international airport.

The tendency of using luggage cart also may differ based on various personal circumstances. It can be depends on the purpose of the travel. In the case of a business trip, people mostly bring the minimum amount of belongings, and the amount is not as much as personal travel because the business trip usually takes only few days. Plus, people may bring many personal items for the personal travel because it is usually for their pleasure, and it takes longer period than a business trip. People tend to use luggage cart when they have many or heavy belongings, and for such reason, people who are on a personal travel use the luggage cart more than the people who are on business trips.

Such inclination of using a luggage cart also depends on the destination. The amount of luggage is not only depends on the purpose of travel and the term, but also depends on the destination of travel, an international flight or a domestic flight. This reason is because the airlines have different baggage regulations (table. 9), and the amount of luggage may be different based on the weather of the destination. Also the international traveler may buy a lot of things at the duty-free shop as gifts for their friends.

Another factor that affects on the usage tendency of the luggage cart is gender. Usually, females tend to use the luggage cart more than do male because a male can bring heavier luggage than a female may travel with her children more frequently than a male does and it is hard to care their children

at the airport while they handle their luggage at the same time. There are more reasons, but these are some of the main reasons why female use luggage cart more than male.

These are the main factors that affect usage difference. However, the baggage regulation causes another issue that recently occurs in the airport. Many airlines have adopted policies to decrease the volume (and therefore weight) of checked-in baggage because of the increasing cost of fuel. The international flights allow the first two pieces of checked-in luggage for free and domestic flights allow a first piece of baggage without extra charge. After most of airlines adopt new luggage policy, however, some international airlines accept a first piece of checked-in baggage for free, but on most domestic flights, travelers have to pay for every checked-in piece. These charges have the effect of encouraging travelers to check in less baggage, but it increases the number, weight and size of carry-on baggage. The number of bags an individual may carry on is limited, but before the airlines adopted the stricter baggage policies, travelers checked in the bulk of their luggage and carried on only as much as they needed on board to avoid the difficulty of transporting everything through the airport after checking in their primary luggage. Since the airlines began charging domestic travelers for the first check-in bag, travelers have instead tried to put everything in their carry-on baggage as much as they can within the regulation. The number and weight of the luggage that people carry in the airport is increasing because of these changes. That means the travelers have to carry all their increased items until the boarding time.

It also causes other issues. Some aircraft cannot accommodate all the carry-on items in their overhead bins, so—at the last moment—the airlines allow (or require) travelers to put their baggage in the cargo hold, just before the flight, at no extra charge. Furthermore, some airlines have recently announced that they will expand the size of their overhead bins to better accommodate the volume of carry-on luggage. This shows that the new luggage policy may make some profits or encourage people to bring only minimum amount of items. However, taking all things into consideration, the positive effects far outweigh the negative effects. These are the reasons why this study regarded a moving luggage as a major issue at the airport and insisted it should be solved. There are more other small or big challenges related to moving luggage at the airport.*

* See Chapter V for more issues that related to the luggage.

Table 9. Baggage Price Chart

Maximum size/weight guidelines

	American Airlines		Delta		Jet Blue		United Airlines		US Airways	
	Domestic / International		Domestic / International		Domestic / International		Domestic / International		Domestic / International	
Approved personal carry-on items	· One personal item · A bag for overhead bin		· One personal item · A bag for overhead bin		· One personal item · A bag for overhead bin		· One personal item · A bag for overhead bin		· One personal item · A bag for overhead bin	
Personal carry-on item restriction	Not exceed 36 inches(LxHxW) and that fits under the seat in front of you.		Purse, briefcase, laptop, or 1 item of a similar size that fits under the seat in front of you.		May not exceed any of three dimensions: 18"(L) x 15"(W) x 8"(H) (45.72 x 38.1 x 20.32cm)		Purse, briefcase, laptop, or 1 item of a similar size that fits under the seat in front of you.		Purse, briefcase, laptop, or 1 item of a similar size that fits under the seat in front of you.	
A bag for overhead bin restriction	Size	22"(L) x 14"(W) x 9"(H) (56 x 35 x 23cm)	Size	22"(L) x 14"(W) x 9"(H) (56 x 35 x 23cm)	Airbus A320	26"(L) x 18"(W) x 12"(H) (66 x 45 x 30cm)	Size	22"(L) x 14"(W) x 9"(H) (56 x 35 x 23cm)	Size	22"(L) x 14"(W) x 9"(H) (56 x 35 x 23cm)
	Total (L+W+H)	45" (114cm)	Total (L+W+H)	45" (114cm)	EMBRA ER190	24"(L) x 16"(W) x 10"(H) (61 x 40 x 25cm)	Total (L+W+H)	45" (114cm)	Total (L+W+H)	45" (114cm)
	Size	62" (158cm)	Size	62" (158cm)	Size	62" (158cm)	Size	62" (158cm)	Size	62" (158cm)
Checked-in baggage requirement	Weight	70lbs.(32kg)	Weight	50lbs.(23kg)	Weight	50lbs.(23kg)	Weight	50lbs.(23kg)	Weight	50lbs.(23kg)
	Price	1 \$25 / Free	Price	1 \$25 / Free	1 Free		Price	1 \$25 / \$0-25	Price	1 \$25 / Free
		2 \$35 / \$0-60*		2 \$35-40 / \$40-80	2 \$40			2 \$35 / \$0-70		2 \$35 / \$0-70
Overweight Checked-in baggage requirement	51-70lbs.	\$100 / \$60-100	51-70lbs.	\$90 / \$0-100	51-70lbs.	\$50	51-70lbs.	\$100 / \$200	51-70lbs.	\$90 / \$150
		\$200 / \$450, or not accepted**		\$150 / \$100-200, or not accepted		\$100		\$200 / \$400		\$175 / \$85-175
	71-100lbs.	\$200 / \$150-200	71-100lbs.	\$175 / \$100-300	63"-80"	\$75	63"-80"	\$100 / \$200	63"-80"	\$175 / \$85-175
Oversized Checked-in baggage requirement	63"-80"	Not accepted	over 80"	Not accepted	over 80"	Not accepted	over 80"	Not accepted		

Prices effective April 2012

* Fees may vary based on your destination. International fees range from free to the maximum shown.

** "Not accepted" refer to instances in which destination country does not allow luggage of this size/weight.

4. THE ISSUES AND VARIOUS DESIGN OF THE LUGGAGE CART

* See more information on Chapter III, section 2
'The Luggage Cart'

This section researches diverse designs of luggage cart and points out the major issues of each design. Most of luggage cart companies produce a luggage cart based on this basic structure.* Almost every luggage cart is made with metal tube for basic structure, and it has similar appearance and function. Also, the usage is the same, but varies in design. The luggage cart is designed for people who use the airport, but it has some issues to be improved for the quality of service.

First of all, I studied about the operation system of the luggage cart. (figure 72) The operation system has been designed for safety issue, but some people have trouble using it because to use the luggage cart, the user has to give a certain amount of pressure to the handle in two ways to move the luggage cart. The user has to press the handle downward, and at the same time push it forward to move. However, some people have trouble with this operating system, so some luggage carts did not adopt this operating system. It solve the difficulty of handling a luggage cart, however, it creates other issues that the luggage cart moves while the user loading their luggage on to it.

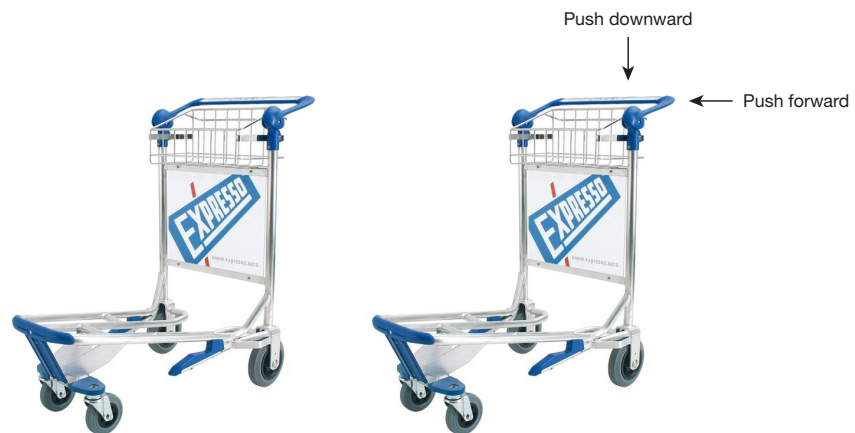


Figure 72. Luggage Cart Operating system

Also, putting baggage on to the luggage cart is another issue. Fortunately, the function mentioned above prevents an accident that causes when the luggage cart moves itself unexpectedly while the user put his baggage on it. However, the size of the luggage cart is limited, so if the user has several luggage, then he has to lift the luggage all the way up to top of the stack of other luggage that are already loaded on the luggage cart. Moreover, the

loading space height is above from the floor about 12 to 15cm, so the user anyway has to lift the luggage to load it on to the luggage cart.

Lastly, the structure has some issues. The structure of loading space does not support the load properly, so sometimes people have trouble because the loads unexpectedly fall down to the ground. Some of the existing carts have improved the structure of the loading space, but still some of the existing carts have issue on a front structure. The front block is located at the very front of the luggage cart to block the luggage from accidentally falling down. However, if it does not support the luggage with enough force and height, then the luggage on the cart may fall down while people move the luggage cart.

Besides these issues mentioned above, some other minor issues can also be found on the luggage cart. For example, the size of the child seat is not enough to handle the children in an age range up to 5 years old or the controlling the direction is difficult, so the user occasionally hit others unintentionally. For providing better service at the airport, the airport has to deal these issues and assist better service.

Figure 73. Incheon International airport,
Incheon, Korea
January 8, 2013
(Outside of security area)
Figure 74. Airport Luggage Cart Issue



Table 10. Luggage Cart Analysis

Case 1.



Figure 75. Luggage cart at Greater Rochester International Airport

Case 2.



Figure 76. Luggage cart at Incheon International Airport

Location	ROC, Rochester, NY	ICN, Incheon, South Korea
Price	\$4	Free
Handle Operation System	Push forward	Push down to move
Front Block	O	O
Small Basket	X	O
Size Variation	Large	Large
Service Area	Outside of security check	Outside of security check
Etc	-	Escalator Accessible

Case 3.



Figure 77. Luggage cart at Incheon International Airport 01

ICN, Incheon, South Korea

Free

Push forward

X

O

Small

Inside of security check

-

Case 4.



Figure 78. Luggage cart at Taipei SongShan Airpor

TSA, Songshan, Taiwan

Free

Push forward

X

O

Small

Inside of security check

-

Case 5.



Figure 79. Luggage cart at Taipei SongShan Airport 01

TSA, Songshan, Taiwan

Free

Push forward

O

O

Large

Outside of security check

-

CHAPTER IV. THE AIRPORT





Figure 80. Airport

1. THE AIRPORT

To design a luggage cart that can solve current issues at the airport, this chapter studied about the airport and considered possible situations that can be happened at the airport. These case studies will help to think about users' needs from their point of view. The airport is a place where various types of planes land or take off. After the invention of the airplane and becoming popular, people can go to many places much faster than when people take other means of transportation, such as trains or ships. People in Europe and many other places take a train a lot to move within the country or even within the continent, but they also take a flight often to go to the other country and most Americans take flights to go to the other states or outside of country more than any other means of transportation such as trains or ships. The airplane allows people to not only move faster but also make possible to go to the other country with reasonable process without big restriction. In this point of view, the airport is considered as a place that connects people in all over the world. It truly made the globalization possible.

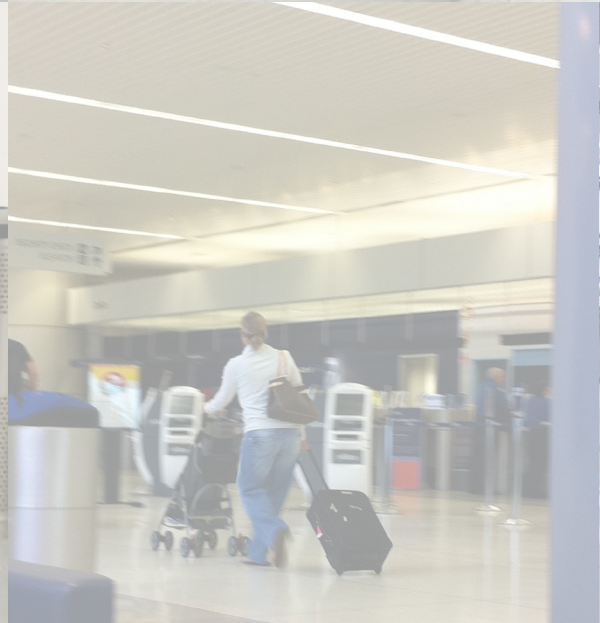
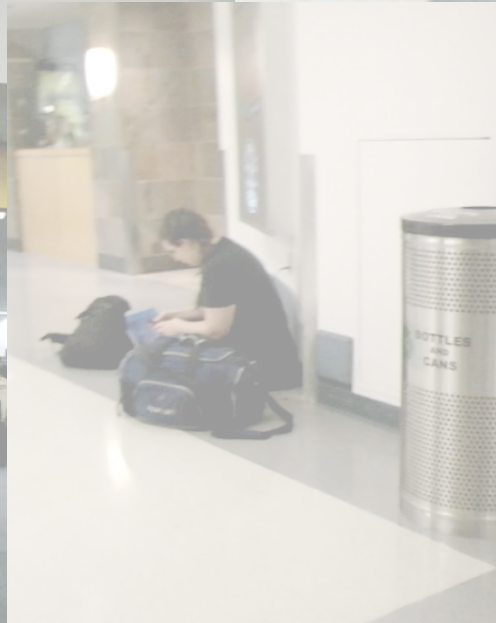
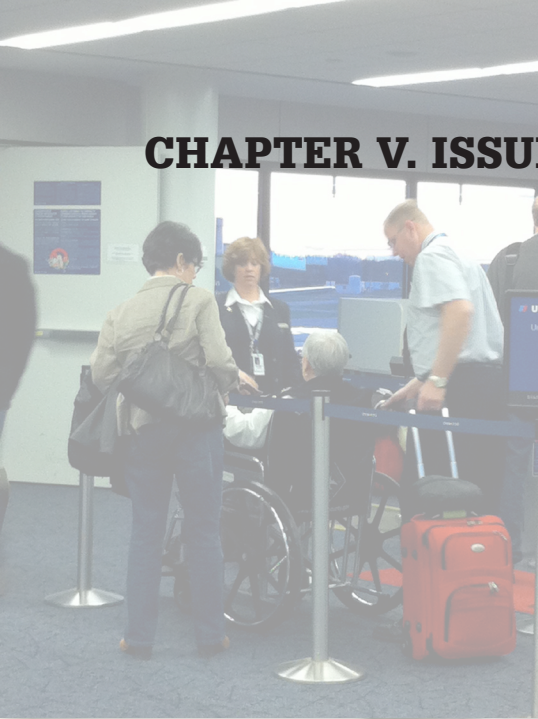
As mentioned at the beginning of the research, an airport is a place that reminds of a hometown to people who are arriving to the airport in their country from the other airport in another country. At the same time, the airport will be the first place to give first impression to a foreigner visiting the country from other countries. Therefore, the airport is a very important place in tourist industry and globalization. We have to study and research about the role and process of the airports so that we can provide better service and find and resolve any existing issues to make an airport as a better service area.

One of the reasons why the airport has to provide better services is because the patrons spend much of their time at the airport until the boarding time. Many travelers arrive at the airport about an hour before a domestic flight, and about two to three hours before an international flight. For a domestic flight, people spend about twenty minutes checking-in and passing through the security check. Thus, the waiting time is not very long from their arrival at the airport to just before boarding on a plane. However, there is an exception for everything, especially at the airport. The boarding gate is changed, and flights are sometimes delayed. These changes that related to their flight schedule make people frustrated and anxious. For international flights, people

spend an average of one to two hours checking in and passing through security. Plus, travelers who need to transfer to another flight may be required to wait at least an hour to the maximum seven hours or more. Therefore, people will constantly worry about the potential changes regarding the flight information, whether that is boarding time, gate number, or the terminal, even after the check-in to avoid missing their flight.

Plus, the airport is a place used by people from all over the world and using various languages, so there are limits to serving and helping everyone at the airport. The number of people, however, who work at the airport is limited, so it is difficult to serve every patron at the airport, especially during the busiest hours. Travelers also move around the airport with their luggage, but they may have some difficulties in navigating around a huge airport with it.

CHAPTER V. ISSUES AND SOLUTIONS





1. HYPOTHETICAL SCENARIO RESEARCH

This section illustrates several major issues at the airport. To find out the major issues, this section shows hypothetical scenarios, in which hypothetical users of the airport and situations are used to pre-determine their needs and major issues. The second research method is an observation. The observation was conducted at the airport to observe the current issues at the airport and to monitor people to see their behavior and needs. Although this information can be obtained from a survey or an interview, people may forget what their major issues were at the airport, even if they had some trouble because the time has been already passed. Lastly, this study includes a survey. These researches will strongly support this study and will show how important this study is.

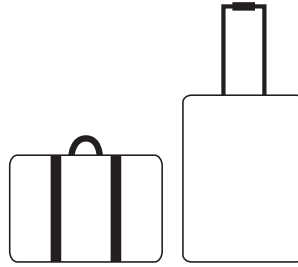
1-1. A General Scenario (International Flight)

The two scenarios (figure 81 and figure 82) indicate the general process of people departing from or arriving at the airport. For the detailed scenario research, the following sections will illustrate the different situations of the different users based on the general scenario, but it will also demonstrate the differences, depending on the purpose of the travel, age and gender.

AIRPORT

Arriving at the airport

Take the preferred transportation to go to the airport



Taking out the luggage

Take out the luggage from the vehicle (either in drop-off or a parking lot)



Moving into the airport



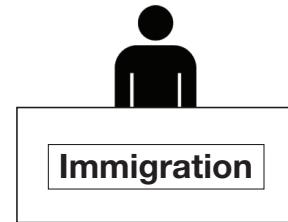
Checking in

Find the right check-in desk and check in



Going through the security

Take off shoes and outerwear and put them into the basket, then go through the security check point



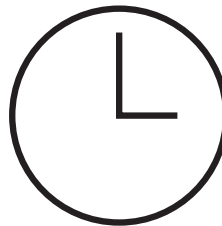
Going through Immigration

Get the passport ready and go through the Immigration check point and get into the service area to wait for the flight



Finding the gate

Check the gate number and find the location



Waiting

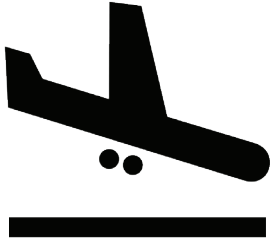
Wait until the boarding time by checking the schedule or gate number in case of a sudden change

Boarding

Boarding

Board the flight by the order of seating zone called from the flight attendant

Figure 81. General Scenario for an International Flight (Departure)



Landing at the airport

After arriving at the airport, prepare all the required forms



Immigration

Going through the Immigration

Foreigners and the locals have different counters to go through the immigration

Baggage Claim

Finding the luggage

Find a right baggage claim by checking the flight number or departure area for checked-in luggage



Customs

Declaring purchases

Fill out a form to declare to the Customs



Leaving the airport

After finishing all the process, leave the airport with preferred transportation

Figure 82. General Scenario for an International Flight (Arrival)

1-2. A Backpack Traveler (International Flight)



Figure 83. Backpack Traveler

Hypothetical user	22-year-old male, college student
Travel purpose	Go to Europe for summer vacation
Airport	Greater Rochester International Airport, Rochester, NY USA to Charles de Gaulle Airport, France (International flight)
The number of luggage	1 backpack

Usually the age range of backpack travelers is from early 20's to mid 30's. This scenario shows the possible story of a man who is in his mid 20's when he takes a flight to go backpacking in France. In this case, he does not have much trouble with his luggage because he only takes a backpack and has enough strength to handle his backpack. At the same time, the backpack travelers mostly prepare only the minimum amount of their needs, so the bag is not very big or heavy to carry. Therefore, most backpack travelers can handle their belongings themselves. The next step is check-in. People have to find their airline's check-in desks, get the boarding passes and check-in their luggage. However, backpack travelers usually do not need to check-in their luggage because they bring only one piece of luggage, which they can carry on. However, they sometimes check-in their backpack, even though they bring only one bag when there is no extra charge to check-in, or if the bag is not qualified to put into overhead bin. The next step is the security check. The security level at the airports were strengthened, so people usually have to take off their jackets, coats, and/or shoes to go through the security check. After the security check, people have to go through the Immigration check point. People can enter the service/waiting area of

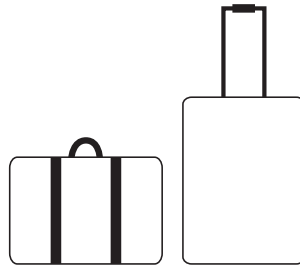
the airport after finishing this step. Once people get into the terminal, they have to check their gate number and location. They will check their gate first, then have some snack or take a look around at the terminal, and they will wait for their flight in front of the gate if it is almost time to board. However, sometimes the gate number can be changed or the flight can be delayed at the last minute, so the passengers have to keep their eye on the flight information. When the boarding time comes, the passengers can board on the flight by the order of seating zone called from a flight attendant.

This hypothetical backpack traveler arrives at the Charles de Gaulle Airport in France. He has to find a way to go to his accommodation following the guidebook because he does not speak French. Most of backpack travelers who travel to the outside of their country will encounter this language problem. People will not have any trouble to speak English in some countries, but they will have hard time to communicate in the most other countries.

AIRPORT

Arriving at the airport

Taking the **taxi** and arrive at the drop-off area in front of the airport



Taking out the luggage

Take out the luggage from the taxi

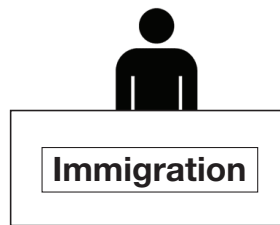


Moving into the airport



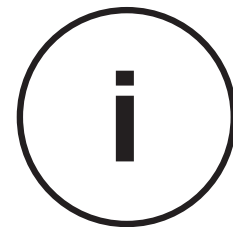
Going through the security

Take off shoes and outerwear and put them and a backpack into the basket, then go through the security check point



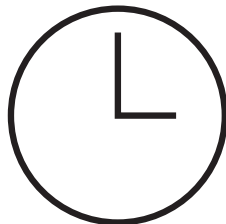
Going through Immigration

Get the passport ready and go through the Immigration check point and get into the service area to wait for the flight



Finding the gate

Check the gate number and find the location



Waiting

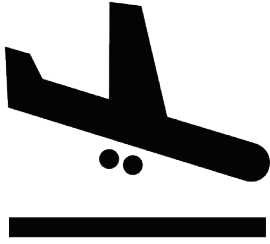
Wait until the boarding time by checking the schedule or gate number in case of a sudden change

Boarding

Boarding

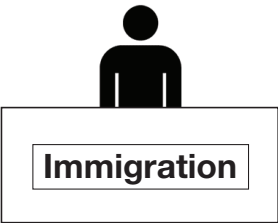
Board the flight by the order of seating zone called from the flight attendant

Figure 84. A Backpack Traveler for an International Flight (Departure)



Landing at the airport

After arriving at the airport, prepare all the required forms and **go to the Immigration** check point



Going through the Immigration

Go to the Immigration desk **for foreigners**



Leaving the airport

After finishing all the process, leave the airport via **subway**

Figure 85. A Backpack Traveler for an International Flight (Arrival)

Possible issues	Departure	Checking-in	He doesn't have check-in luggage, but he has to wait for a long time because there are not enough self check-in machines at the airport in Rochester and there is a long line because the school's summer vacation has just started.
		Waiting	He has to keep his eye on his flight status just in case of sudden changes. It may affect to the following flights because he has to transfer his flight to go to the France.
	Arrival	Leaving the airport	He has to follow the sign carefully and check the guidebook to find a way to go to the guesthouse. Otherwise, he has to find someone to help him, but it will be hard since he only speaks English.

Table 11. Possible Issues of a Backpack Traveler for an International Flight

1-3. A Family Travelers (Domestic Flight)



Figure 86. Family Traveler

Hypothetical user	11-year-old girl, Student
	13-year-old boy, Student
	40-year-old female, Housewife
	43-year-old male, Businessman
Travel purpose	Go to another state for summer vacation for 2 weeks
Airport	Chicago O'Hare International airport, Chicago, IL, USA to Los Angeles International Airport, Los Angeles, CA (Domestic flight)
The number of luggage	3 Check-in pieces of luggage, 2 Carry-on Luggage and 3 personal bags

081

This scenario studies about a family of four to find out their usual behavior at the airport and their needs or difficulties. This scenario shows a family who parks their car in the parking lot at the airport because they have difficulties to take public transportation with their children and several pieces of luggage. At the same time, the parents have to take care of not only their kids, but also the family's luggage. Plus, this travel is for a vacation, so they have many more belongings than a person who is on a business trip.

This family needs a luggage cart to move their luggage more easily since they have several pieces of luggage, but even finding a cart will not be easy. Some airports have a clear sign for the location of luggage cart,

so people can find it easily. After the family enters the airport, they try to find their airline's check-in desk. In this case, the parents mostly check in their luggage as much as they can for convenience. The reason is that the parents are busy taking care of their kids, even when they have not much belongings to take care of. Also, this family travels for 2 weeks, so they have many belongings. They have to check-in 3 pieces of luggage because the size of those luggage is too big to carry on the flight. They still have 2 carry-on baggage and 3 personal items.

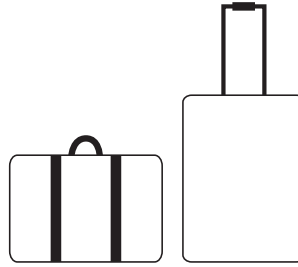
The security check process is the same as for the other travelers. However, finding the gate and checking for a flight status are another problem for this family. Sometimes, people even have to move from terminal to terminal because of this change of flight status. While doing that, even some people may lose their way without proper signs, or lack of information. For the travelers with their kids, every minor difficulty can be a big problem. In this case, the foregoing parents have some problems with handling the luggage and their kids at the same time, but the parents with more kids or a single parent is expected to have more difficulties.

After landing at the airport, the travelers get off the flight, check the flight information, and go to the baggage claim to find their luggage. This case mostly has issues related to the moving with respect to the luggage or their children. It is better to use the airport luggage cart when they have several pieces of luggage to move after picking up the luggage from the baggage claim. The reason is that usually the airport is big for people to walk around and even moving through the big airport with their luggage will make them tired easily. After all the arrival processes, they will look for a rental car service desk to rent a car.

AIRPORT

Arriving at the airport

Park a **family car** in a long-term parking lot



Taking out the luggage

Take out the luggage from the vehicle



Moving into the airport

Need a luggage cart to move their luggage to the airport



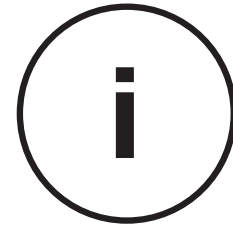
Checking in

Find the right check-in desk and check in



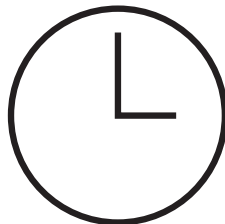
Going through the security

Take off shoes and outerwear and put them into the basket, then go through the security check point



Finding the gate

Check the gate number and find the location



Waiting

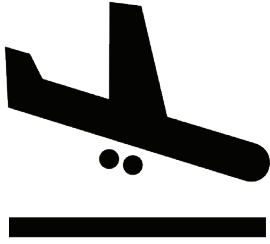
Wait until the boarding time by checking the schedule or gate number in case of a sudden change

Boarding

Boarding

Board the flight by the order of seating zone called from the flight attendant

Figure 87. Family Traveler for a Domestic Flight (Departure)



Landing at the airport

After arriving at the airport, prepare all the required forms

Baggage Claim

Finding the luggage

The family has to find a right baggage claim by checking the flight information.



Leaving the airport

After finishing all the process, leave the airport with preferred transportation

Figure 88. Family Traveler for a Domestic Flight (Arrival)

Possible issues	Departure	Moving to the airport	They have 5 pieces of big luggage, including check-in and carry-on luggage and 3 pieces of personal bags. Thus, it is better to use a luggage cart to move all items at the same time. However, it may be hard to find a luggage cart.
		Waiting	They will keep checking the flight status and cannot relax until they board on a flight because they had a previous experience when they almost missed their flight when their gate number was changed at the last minute, but they didn't know that until the airport announced it to the public. Therefore, they had to go to a different terminal by taking a small train. They barely made it until the worker at the airport helped them.
	Arrival	Leaving the airport	They have to find a rental car service desk, but they have to walk for a while. Thus, it is better to use a luggage cart, but it is not easy to find a one.

Table 12. Possible Issues of a Family Traveler for a Domestic Flight

1-4. A Business Travelers
(Domestic Flight)



Figure 89. Business Traveler

Hypothetical user	35-year-old male, businessman
Travel purpose	Go to business trip to other state
Airport	Greater Rochester International Airport, Rochester, NY USA to Chicago O’Hare International airport, Chicago, IL, USA (Domestic flight)
The number of luggage	One carry-on luggage and one personal item

This scenario illustrates a case of a 35 years old businessman who goes on a business trip. This case assumes that he parks his car at a parking lot. Most business trips take only within a week, so the amount of belongings is quite minimal, compared to that of families because the purpose of a business trip is to attend a few meetings or a conference.* Therefore, there is not much trouble, even when the parking lot is far from the airport, but finding the way to the right check-in desk might be a problem if it is a huge international airport. In this case, this business traveler is only taking one brief case and one small carrier. He can check-in the small carrier or he can put it in overhead bin. It sometimes depends on their preference or whether they have to pay for it. In this case of a businessman, he did not check-in his luggage because he needs it to do some work while waiting for or during the flight.

* This study excludes a business travel, which takes longer than a week because this study regards it as an exceptional case.

He can spend his free time at the airport more freely than other travelers. However, he has to check the flight status often because it is possible that the gate number is changed or the flight is delayed. Plus, he may

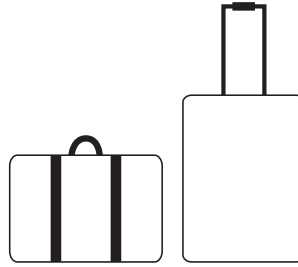
have trouble using the restroom because he still has his luggage. Some airports have big stalls to put belongings for each toilet in the restrooms, but some do not. Otherwise, he may move more easily than other travelers before boarding.

As same as the general scenario, he will get off the flight. He can get out from the airport without waiting for his luggage, since he does not have any check-in luggage. He will rent a car at the airport and leave the airport. As this scenario mentioned before, he is on a short business trip, so he has only small amount of belongings. Thus, he has not much trouble to move around the airport, even if it is a huge international airport.

AIRPORT

Arriving at the airport

Park his car in the short-term parking lot.



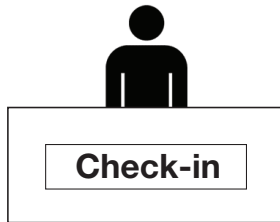
Taking out the luggage

Take out the luggage from the vehicle



Moving into the airport

Enter into the airport with his luggage.



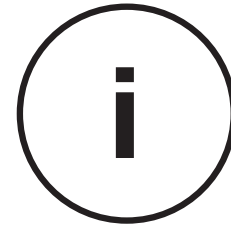
Checking in

Find the right check-in desk and check in



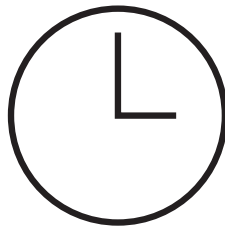
Going through the security

Take off shoes and outerwear and put them into the basket, then go through the security check point



Finding the gate

Check the gate number and find the location.



Waiting

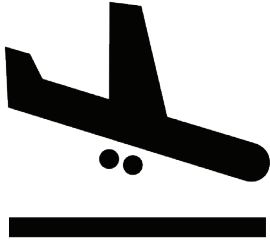
Wait until the boarding time by checking the schedule or gate number in case of a sudden change and have some snack.

Boarding

Boarding

Board on the flight by the order of seating zone called from the flight attendant.

Figure 90. A Business Traveler for a Domestic Flight (Departure)



Landing at the airport

After arriving at the airport,
prepare all the required forms



Leaving the airport

After finishing all the process,
rent a car and left the airport.

Figure 91. A business traveler for a Domestic Flight (Arrival)

Possible issues	Departure	Getting flight information	He has to check the flight status often because it is possible that the gate number is changed or the flight is delayed.
		Waiting	He may have trouble using the restroom because he still has his luggage. Some airports have big stalls to put belongings for each toilet in the restrooms, but some do not.
	Arrival	Leaving the airport	They have to find a rental car service desk, but they have to walk for a while. Thus, it is better to use a luggage cart, but it is not easy to find a one.

Table 13. Possible Issues of a Business Traveler for a Domestic Flight

1-5. A Personal Traveler on a Wheelchair (Domestic Flight)



Figure 92. A Personal Traveler on a Wheelchair

Hypothetical user	70-year-old female, housewife
Travel purpose	Go to personal travel to other state to visit her family
Airport	Philadelphia International Airport, Philadelphia, PA USA to John F. Kennedy International Airport, New York, NY, USA (Domestic flight)
The number of luggage	One carry-on luggage, One Wheelchair and one personal item

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This scenario demonstrates a story of a 70-year-old lady on a wheelchair, who travels to the airport alone. When she goes to the airport, she cannot drive herself so she may use the transportation service offered by local service or by the government. After arriving at the airport, it is still hard to move luggage by herself on a wheelchair, so she will have to receive help from the airport or the airlines. The helper will carry her luggage and bring her to the check-in desk. She will check in her luggage and only bring her small bag. She can check in her own wheelchair and use the wheelchair offered by the airport or she can use her own wheelchair depending on the security policy of the airport. She might have some difficulties during the security check and needs help.

Once she gets in to the service area after the security check, she has to wait before the boarding time as the others do. The waiting will not be a big problem, but doing something else while waiting will make some

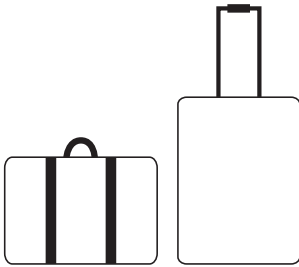
issues for her. For instance, she has to find a restroom that has a room for a disabled people, so that she has enough space for her wheelchair. Otherwise, she needs help from others. She will board before others do and someone will help her.

When the flight is landed at the airport, she will get off the flight and meet a helper in front of the flight gate then she can get on a wheelchair. She has to check the flight information again to find a right baggage claim to get the checked-in luggage. She cannot get her luggage herself from the luggage claim, so the helper will do it for her. After finishing these arrival processes, she will meet her family. She does not have to spend a long time at the airport and does not need as much help from others as when she takes on a flight.

AIRPORT

Arriving at the airport

Use transportation service, and arrive at the drop-off area of the airport



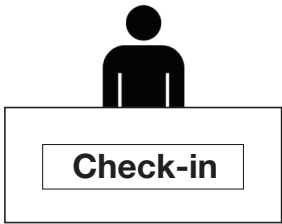
Taking out the luggage

Need help taking out luggage from the vehicle



Moving into the airport

Need help entering into the airport with her luggage



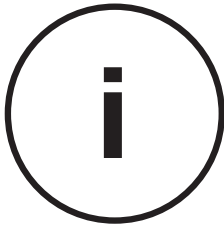
Checking in

Find the right check-in desk and check in



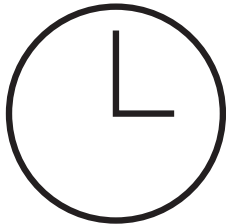
Going through the security

Need help going through the security



Finding the gate

Need help to check the gate number and find the location



Waiting

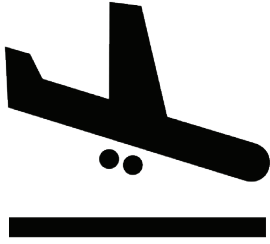
Wait until the boarding time by checking the schedule or gate number in case of sudden change

Boarding

Boarding

Need help boarding on the flight

Figure 93. A Personal Traveler on a Wheelchair (Departure)



Landing at the airport

Reserve transportation before taking a flight. She can **get help** from the airport after getting off the flight

Baggage Claim

Finding the luggage

Find a right baggage claim by checking the flight number or departure area. She can get help from someone who works at the airport to get luggage



Leaving the airport

Meet her family, and leave the airport

Figure 94. A Personal Traveler on a Wheelchair (Arrival)

Possible issues	Departure	Arriving at the airport	She cannot drive herself so she may use the transportation service offered by local service or by the government.
		Taking off the luggage	She need help to move her luggage.
		Waiting	She needs help to using the restroom.
		Boarding	She need help to board on a flight.
	Arrival	Landing at the airport	She needs help from the airport right after getting off the flight.
		Finding the luggage	She needs someone to find her luggage from the baggage claim.

Table 14. Possible Issues of a Personal Traveler on a Wheelchair

2. OBSERVATION RESEARCH

The second method to research existing issues at the airport is observations. As mentioned before, this study includes several research methods, such as making up hypothetical scenarios, observing people at the airport and conducting a survey to know existing or possible issues and the traveler's needs to consider all the possible way to serve better. The final design was created based on these researches, so these researches strongly support the concept and the design of this study. This section shows the travelers at the different airports. This observation is important because the observer can get information directly from the actual situation. This information may be somewhat similar to the information gained from the survey or interview. However, people may not remember the details or their memory may distort some facts. Thus, this observation will back up the lacking details of the survey.

This observation research was conducted at the several airports in Korea and USA from 2011 to 2013. The interesting point from the observation was the number of people who use a luggage cart (See chapter III for more information). All the issues and possible solutions founded from this research are in the Section 4 of Chapter V.

Figure 95. Greater Rochester International Airport, Rochester, NY, USA, December 16, 2011 (Inside of security area)

Figure 96. Chicago O'Hare International airport, Chicago, IL, USA, December 16, 2011 (Inside of security area)





Figure 97. Chicago O'Hare International airport, Chicago, IL, USA, December 16, 2011
(Inside of security area)



Figure 98. Philadelphia International airport, Philadelphia, PA, USA, January 16, 2012
(Inside of security area)



Figure 99. Philadelphia International airport, Philadelphia, PA, USA, January 16, 2012
(Inside of security area)

Figure 100. Philadelphia International airport,
Philadelphia, PA, USA, January 16,
2012
(Inside of security area)



Figure 101. Philadelphia International airport,
Philadelphia, PA, USA, January 16,
2012
(Inside of security area)

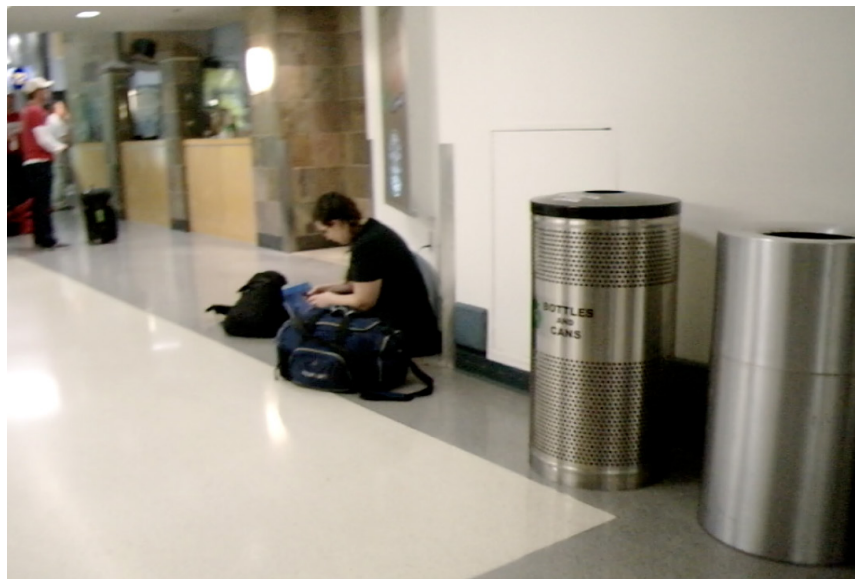


Figure 102. Greater Rochester International
Airport, Rochester, NY, USA,
January 10, 2012
(Outside of security area)





Figure 103. Incheon International airport,
Incheon, Korea, January 8, 2013
(Outside of security area)



Figure 104. Incheon International airport,
Incheon, Korea, January 8, 2013
(Outside of security area)

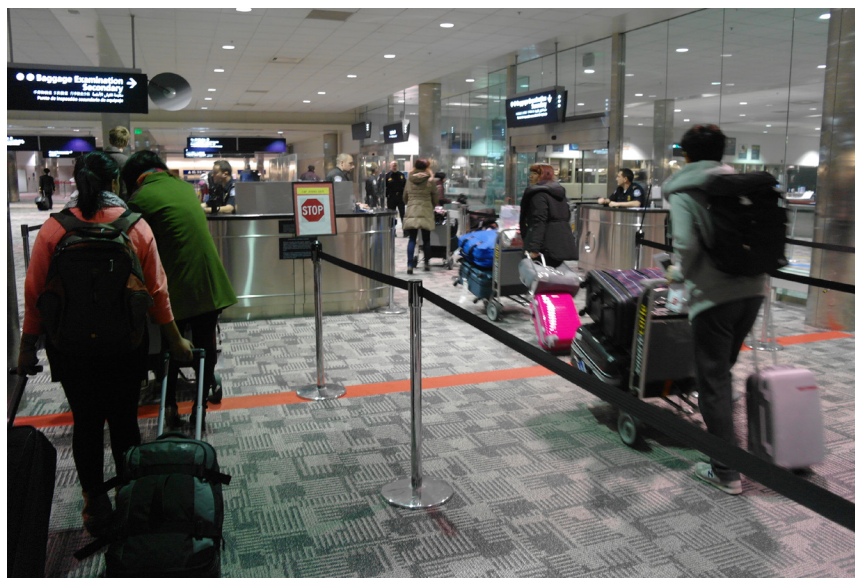


Figure 105. Detroit Metropolitan Wayne County
Airport, Wayne, MI, USA, January
16, 2013
(Inside of security area)



Figure 106. Detroit Metropolitan Wayne County Airport, Wayne, MI, USA, January 16, 2013
(Inside of security area)



Figure 107. Detroit Metropolitan Wayne County Airport, Wayne, MI, USA, January 16, 2013
(Inside of security area)



Figure 108. Incheon International airport, Incheon, Korea, January 16, 2013
(Inside of security area)

3. SURVEY RESEARCH

The main purpose of this survey is to know the travelers' needs and their issues at the airport. The reason for conducting this survey is to find out the factors that may cause some issues at the airport. Many of the existing issues at the airport and the factors that cause those issues are related together. Therefore, there are many different factors that affect the usage tendency of a luggage cart. This research mainly focuses on the factors that cause some issues related to a luggage or a luggage cart. However, this research not only studies issues that are related to a luggage or a luggage cart, but also studies some inconvenient experience of the travelers. This survey was done along with a brief personal interview so that it is not just people marking on a few questions on the paper, but also to understand their personal experience. This survey was conducted to 114 participants in a wide different range of age and asked them to answer following questions based on their travel experience over the past five years.

Survey no. _____

The main purpose of this survey is to research the usage inclination of the luggage cart and the other issues at the airport for academic reasons. The result of this survey will be included in my thesis. Thank you for your time to take this survey.

1. What is your job?

2. How old are you?

☐ 10-19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50+

3. What is your gender?

☐ Male ☐ Female

Please answer the following questions based on your travels over the past five years.

1. What is your major purpose of travel? (Check one)

☐ Personal travel ☐ Family business
☐ Business trip ☐ School
☐ Other _____

2. Once you travel, how long do you stay after the flight on average?

☐ 1-4day ☐ 5-9days ☐ 10-19days ☐ 20-29days ☐ 30+

3. When did you mostly travel? (Check all that apply)

☐ Spring ☐ Summer ☐ Fall ☐ Winter

4. Which do you use more often?

☐ Domestic flight ☐ International flight ☐ Both equal

5. How many pieces of luggage did you carry on the plane on average?

☐ 0 ☐ 1 ☐ 2 ☐ Other _____

6. How many pieces of luggage did you check in on average?

☐ 0 ☐ 1 ☐ 2 ☐ Other _____

6-1. If you check in your luggage, how much did you pay for each on average (or typically)?

☐ \$1-50 ☐ \$50-100 ☐ \$100-150 ☐ \$150-200 ☐ Other _____

7. When you travel, do you mostly travel with a companion?

☐ No, I travel alone. ☐ Yes, 1-3 companions
☐ Yes, 3-5 companions ☐ Yes, more than 5 companions

8. Have you traveled with someone who needs your assistance? (Check all that apply)

☐ No ☐ Children ☐ Elderly ☐ Other _____

8-1. When you traveled with someone needing your help, did you have any issues with the following at the airport? (Check all that apply)

☐ Moving Luggage ☐ Find a place ☐ Check-in
☐ Security check ☐ Immigration ☐ Shopping
☐ Use the restroom ☐ Check the flight schedule
☐ Other _____

9. Have you personally had any issues with the following at the airport? If you did, then what issues did you have? (Check all that apply)

☐ Moving Luggage ☐ Find a place ☐ Check-in
☐ Security check ☐ Immigration ☐ Shopping
☐ Use the restroom ☐ Check the flight schedule
☐ Other _____

10. Have you used a luggage cart at the airport? How was it?

☐ No, I didn't use
☐ Very bad ☐ Bad ☐ Fine ☐ Good ☐ Very good

10-1. What was the reason?

10-2. If you used a luggage cart at the airport, where did you use the luggage cart? (Check all that apply)

☐ Before the security check (from the vehicle to the security check)
☐ After the security check (after the security check to the gate)

10-3. If you used a luggage cart at the airport, what was the main reason? (Check all that apply)

☐ The amount of luggage ☐ The weight of luggage
☐ Children ☐ Other _____

10-4. When you used a luggage cart, did you pay for it? How much did you pay on average?

☐ \$1-5 ☐ \$6-10 ☐ \$11-20 ☐ Other _____

10-5. If you didn't use a luggage cart, what was the main reason?

☐ No luggage cart (Hard to find) ☐ Difficulties using
☐ No luggage ☐ Price
☐ Used other service _____ ☐ Other _____

11. If the airport provides a better luggage moving service, would you be willing to pay for it?

☐ No, I won't ☐ I can pay up to \$5
☐ I can pay up to \$10 ☐ I can pay more than \$10
☐ Other _____

A survey for MFA thesis at Rochester Institute of Technology.

Thank you for taking the time to complete this survey.

Survey Results

(Total of 114 Participants, except Chart 14)

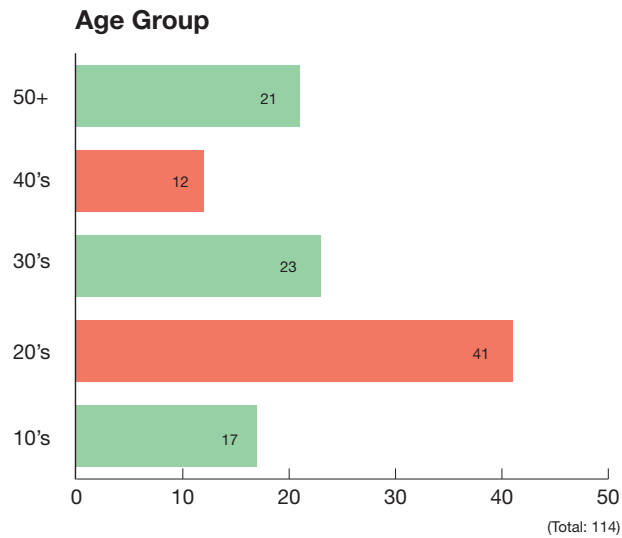


Chart 3. Survey – Age Group

Most teenagers who participate on this survey are in a high school and most in their 20’s are in a college. Most in their 30’s are in all different area such as an art, business, education and some of them study in a graduate school. Most in their 40’s and 50’s have their own business or are faculty in Rochester Institute of Technology or University of Rochester.

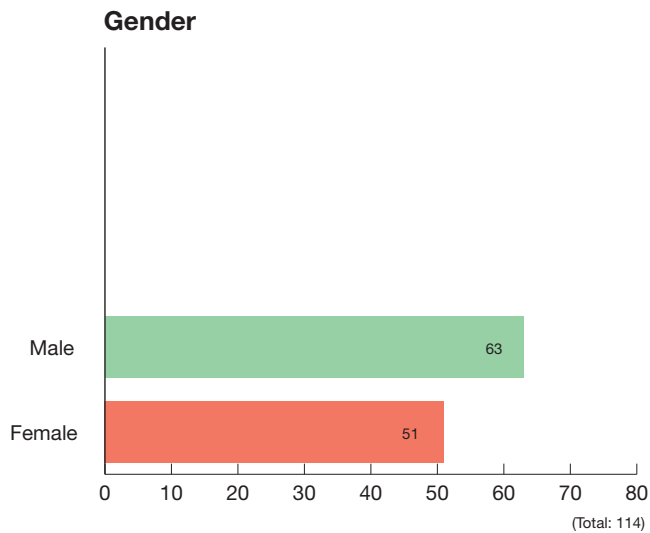


Chart 4. Survey – Gender

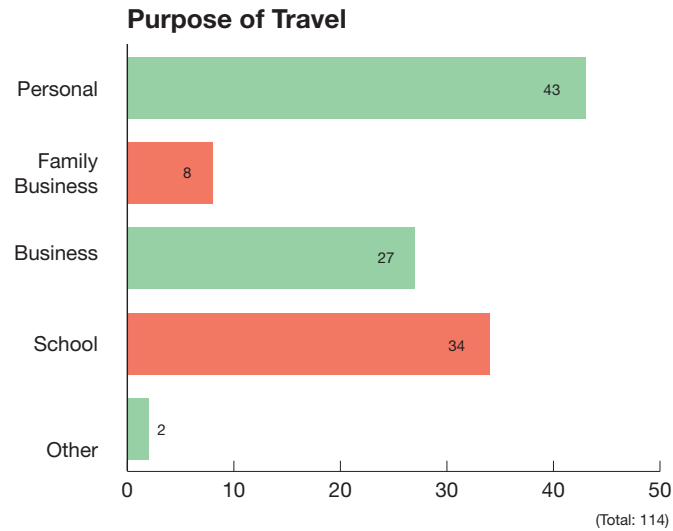


Chart 5. Survey – Purpose of Travel

The question number 5 on the survey sheet was asked to the travelers to find out a major purpose of their travels. The main aim of this question is because a purpose of travel affects the number of luggage and the number of luggage affects the usage of the luggage cart. Each respondent was required to select only one major reason among five reasons even though they have traveled several times for all different reasons. The main purpose of their travel is personal. Those respondents mainly travel to the other states in America or to another country for their vacation. The next main reason is traveling for their school. The respondents who answer this question usually take a flight to go to school or take a flight to come back to their house during school vacation. About one fifth of the respondents are the international students. They usually take international flights to visit their parents in another country. The third biggest reason for their traveling is business and most of them are in the age range of mid 30's to late 40's. The religious missions and a job interview were included under Other.

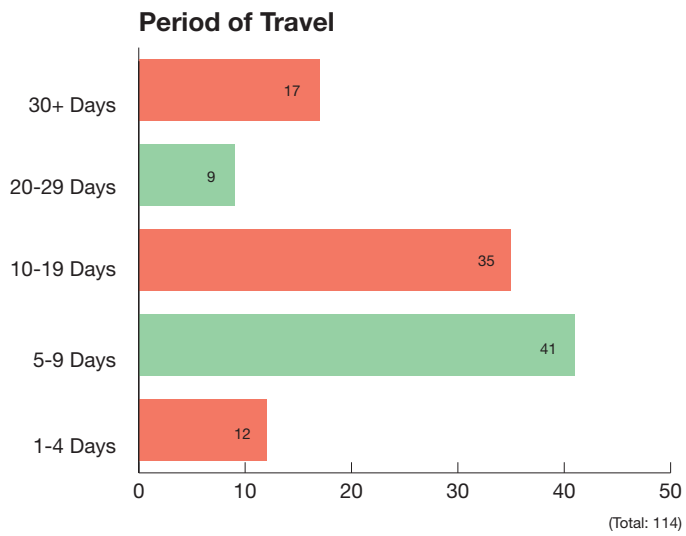


Chart 6. Survey – Period of Travel

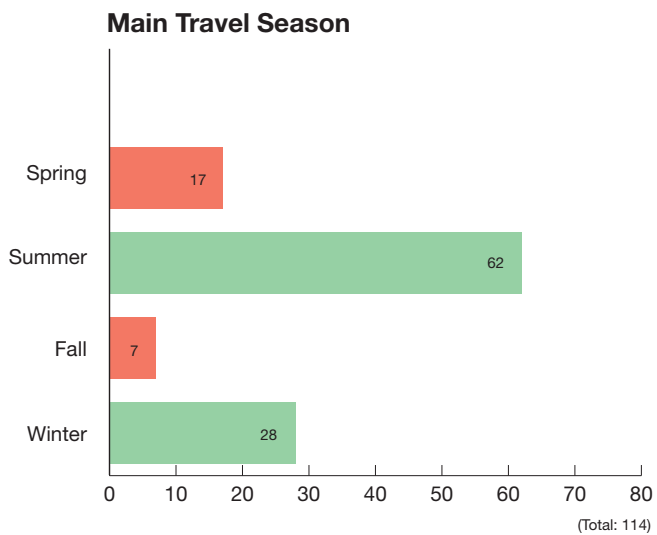


Chart 7. Survey – Main Travel Season

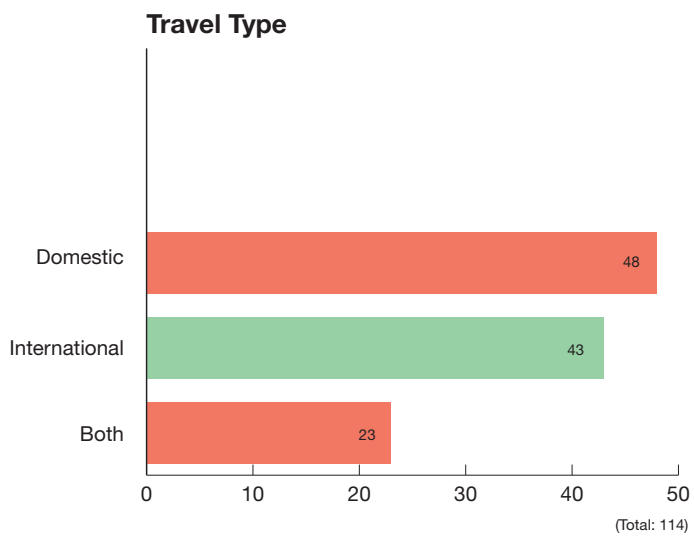


Chart 8. Survey – Travel Type

Three factors that can affect the number of luggage are a period of travel, travel season and travel type. The result shows that those factors are strongly related to the purpose of the travel. The question about the travel season shows that the most of respondents travel during summer. Usually, the people who travel in spring or fall take the trip for business purposes. People travel for personal reason, family business, school or others during summer. The interesting result from the travel type was that about one fifth of the respondents responded that their travel type is split evenly for both domestic flight and international flight. Plus, the rest of the respondents responded almost equally to each domestic flight or international flight.

Chart 9. Survey – The Number of Carry-on Items

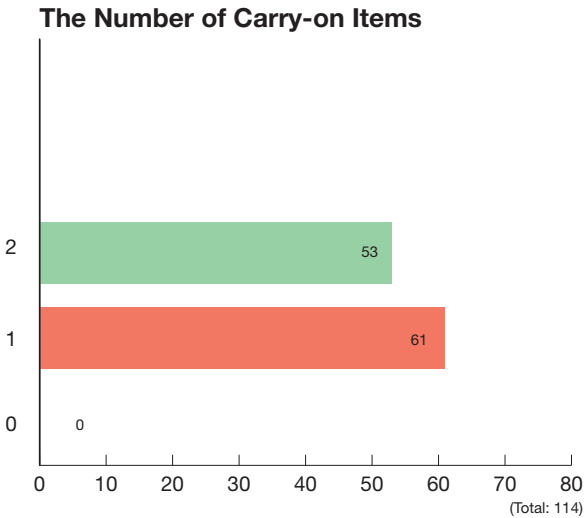
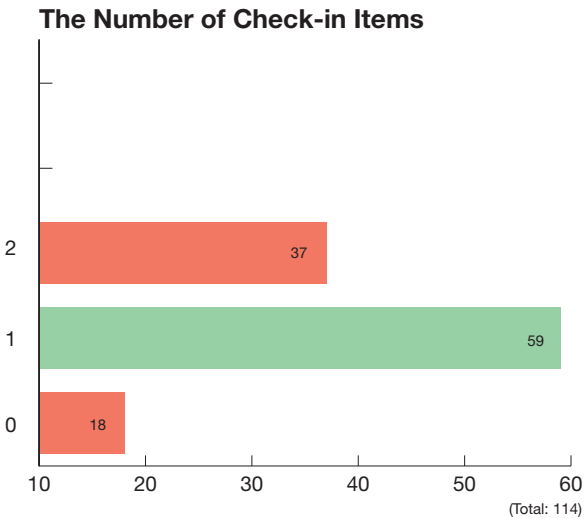


Chart 10. Survey – The Number of Check-in Items



The survey results of Charts 9 and 10 were gained from the most essential questions, which are about the number of carry-on items and the number of check-in items. The number of items is the main reason to use an airport luggage cart (see the Section 3 of Chapter III to see the details of usage tendency of the airport luggage cart). At the same time, a traveler may have more issues than the others when the traveler has more items to carry.

The Number of Companion

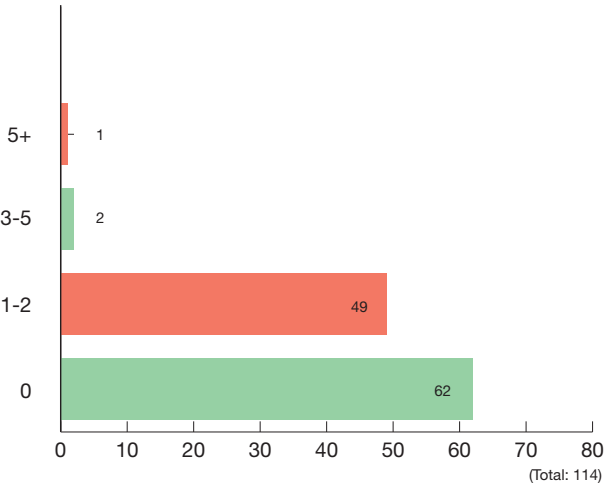


Chart 11. Survey – The Number of Companions

The question about the number of companions was conducted under the assumption that the traveler may use an airport luggage cart, together with their companion, when they have several pieces of luggage in total because they may want to move their luggage easily together instead of handling each of their luggage by themselves. This may be especially true for parents who prefer to use a luggage cart when they travel with their children.

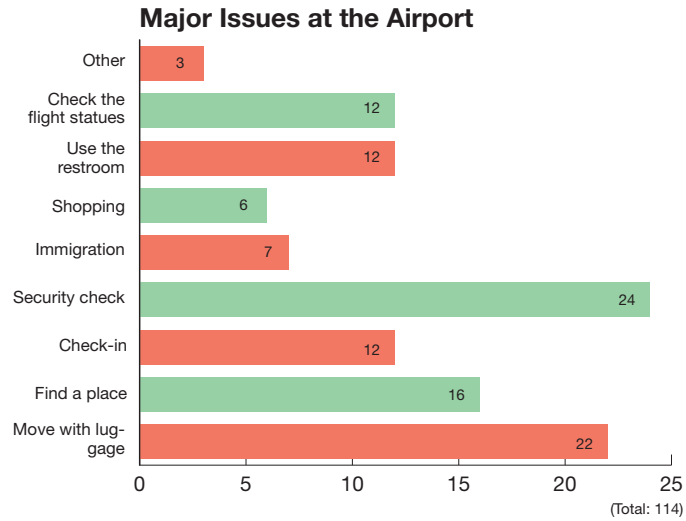


Chart 12. Survey – Major Issues at the Airport

The Chart 12 indicates how many people have issues and what type of issues they have. The list of issues was determined from the results of observation research. The respondents were asked to answer only one major difficult issue from their experience over the past five years. Only four respondents answered other and they had no problem at the airport. The main reason why people have difficulties in finding a place is strongly related to the communication problem, either speaking a different language or finding a person for help.

Luggage Cart Usage Experience

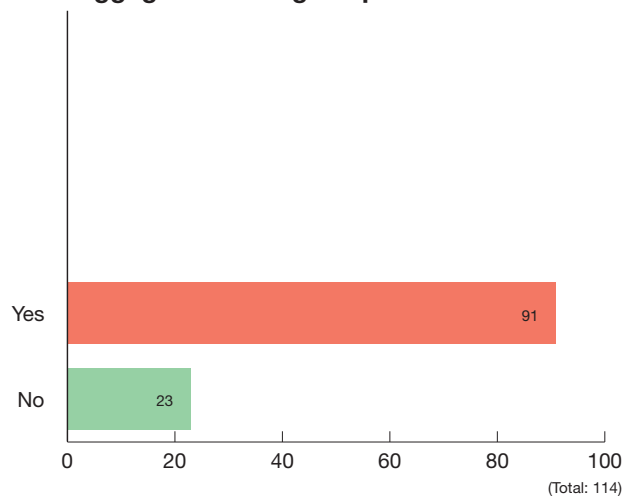


Chart 13. Survey – Luggage Cart Usage Experience

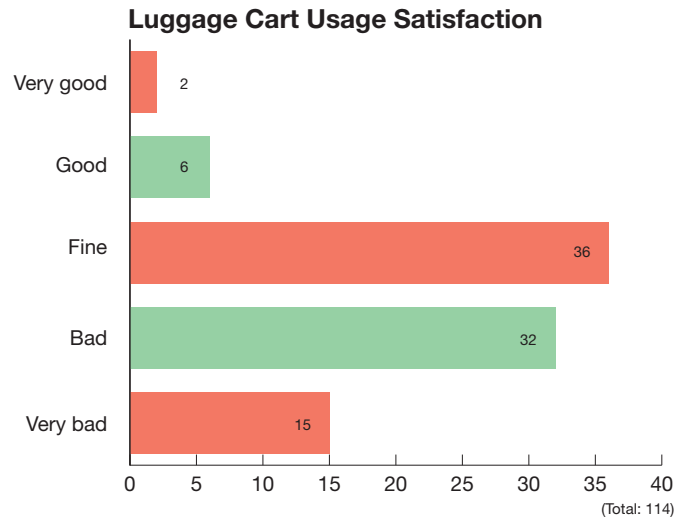


Chart 14. Survey – Luggage Cart Usage Satisfaction

Overall, about one-fifth of all respondents have not used a luggage cart and about four-fifths of all respondents have used a luggage cart at the airport over the past five years. The main reasons for not using the luggage cart at the airport are either they did not have many pieces of luggage to use a luggage cart or they could not find it. About 92% of the respondents who have used a luggage cart answered that their satisfaction of the luggage cart experience was fine, bad, or very bad, and only 8% of people answered that they were satisfied with the existing luggage cart. Moreover, about 90% of the respondents expect to have a better luggage cart or service at the airport and most of them are willing to pay for the better service.

4. ISSUES AND POSSIBLE SOLUTIONS

This section illustrates all the major issues that were found in the previous research and some possible solutions. All the issues are listed under a main keyword. It is possible that there are more issues at the airport, which are not listed in this section. However, I believe that the issues in this section can cover almost every issue at the airport, even though the Table 12 does not describe all the details. The issues listed on Table 12 prove the necessity for better service at the airport. The possible solutions listed on Table 12 are not selected solutions for the final design. The selected solutions are applied to the final design.



Figure 110. Issues 01



Figure 111. Issues 02

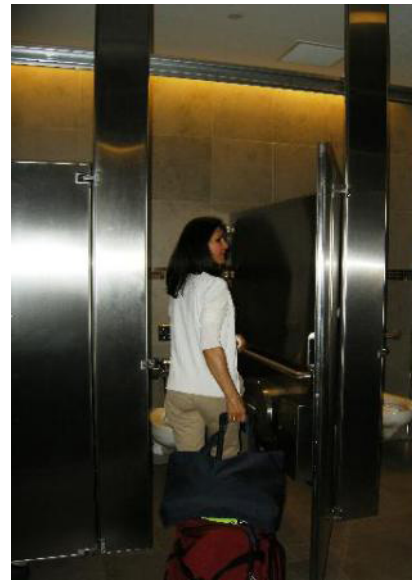
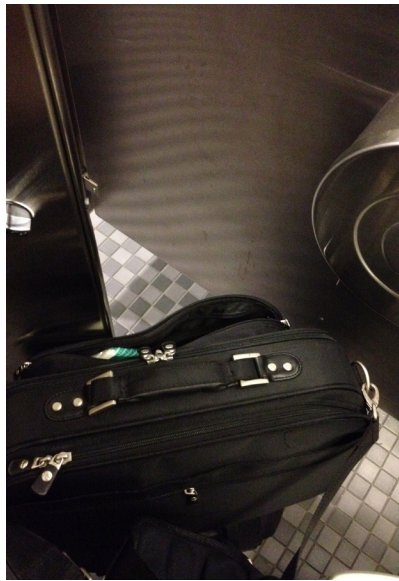


Figure 112. Issues 03
Figure 113. Issues 04

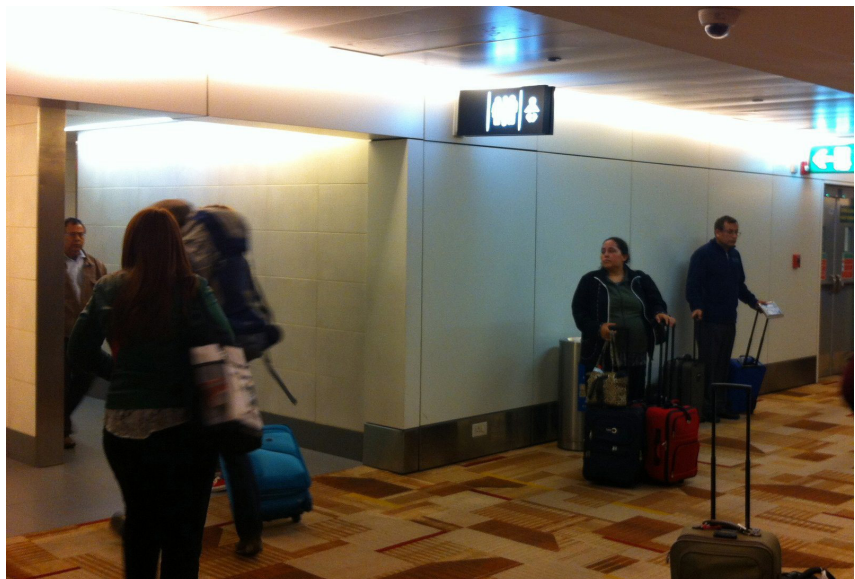


Figure 114. Issues 05



Figure 115. Issues 06



Figure 116. Issues 07
Figure 117. Issues 08

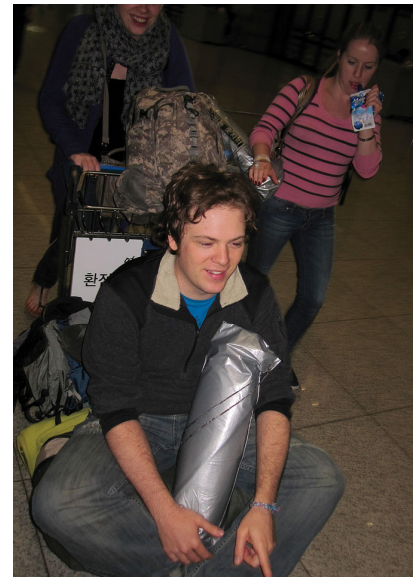


Figure 118. Issues 09
Figure 119. Issues 10



Figure 120. Issues 11



Figure 121. Issues 12



Figure 122. Issues 13

Table 15. Issues and Possible Solutions

Keyword	Issue	Possible solution
Finding a place	Finding a way to go to a specific location	Direct connection with information center
		GPS
	Finding a nearest map	GPS
Check-in	Waiting time	A device that shows estimated waiting time
	Waiting time	A device that shows a check-in desk with a shortest waiting line
	Waiting for a check-in desk without luggage	Self check-in system
	Finding a right check-in desk at the huge international airport	GPS
Security check	Waiting time	A device that shows a security checkpoint with a shortest waiting line
	Going through all the security check process with several belongings	A luggage cart that can go through the security check together
Immigration	Waiting time	A device that shows estimated waiting time
		A device that shows a immigration desk with a shortest waiting line

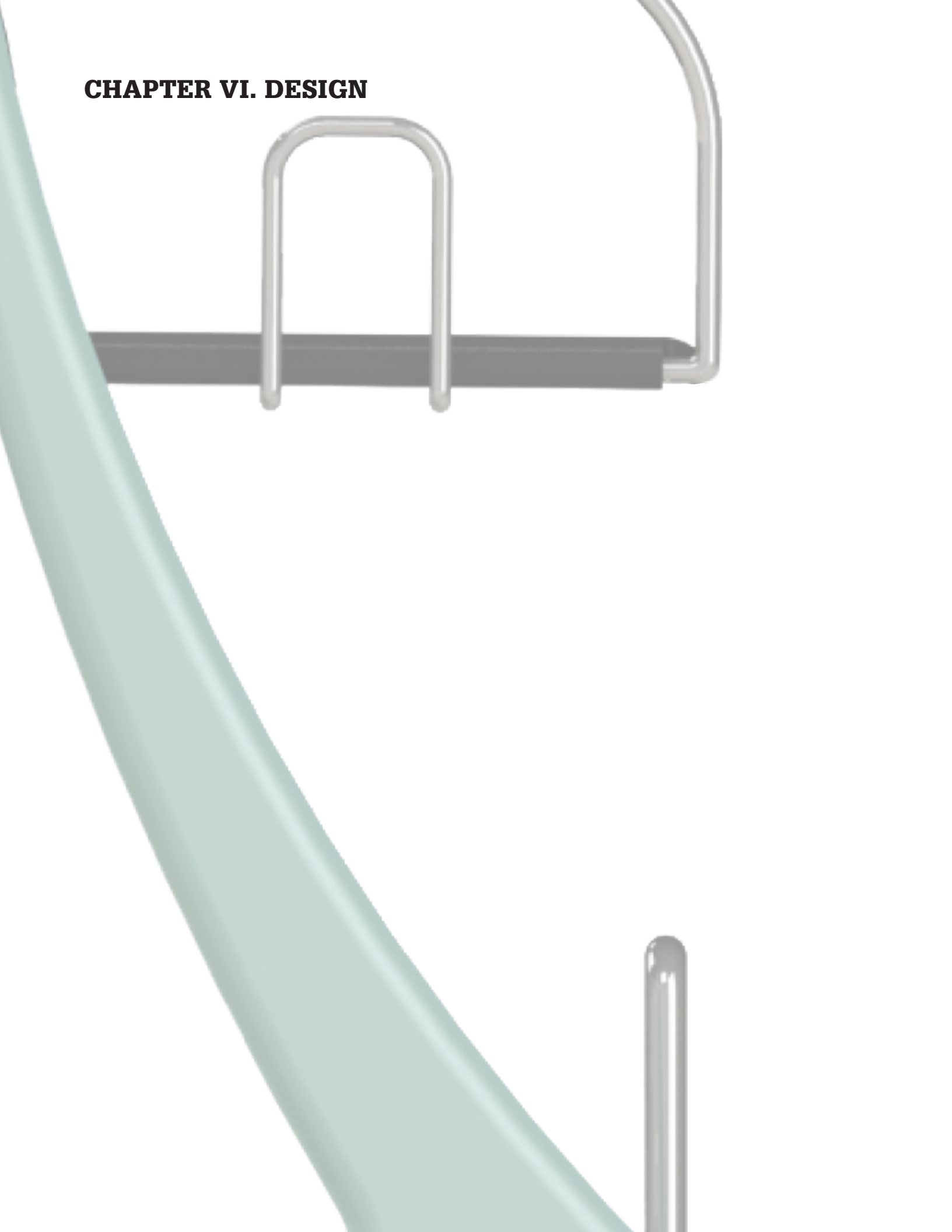
Keyword	Issue	Possible solution
Shopping	Shopping with several belongings, such as several pieces of luggage or purchased item	A luggage cart to move several belongings at the same time
		A luggage cart that can protect user's belonging while they shop
Checking the flight status	Finding a schedule board	An information device that shows user's flight schedule with detailed information
	Finding a specific flight schedule on a big schedule board with all the flight schedules	
	Getting detailed flight information, such as boarding time or gate number	
	Getting up-to-date flight information	An information device that can update user's flight schedule automatically and sets off an alarm when it gets new information
Getting information	Finding a nearest map	GPS
	Finding a current location at the map	
	Getting information about checked-in luggage	A device that shows a checked-in luggage status

Keyword	Issue	Possible solution
Getting information	Communicating with people	A device that has all the information about the airport
	Finding a information desk	
	Finding a right luggage claim	A big sign
	Getting information about the destination	A device that shows most up-to-date information about the destination
Moving	Traveling with a baby	A luggage cart for a baby
	Traveling with a stroller	A luggage cart that can attach a stroller
	Travelling with the elderly	A luggage cart for the elderly
	Travelling with someone who needs help	A luggage cart that can help user
	Travelling with a wheelchair	A luggage cart that can be used by someone who uses a wheelchair
	Getting tired easily to walk around the huge airport	A chair
Service	Finding a place to seat on	GPS
		A portable chair

Keyword	Issue	Possible solution
Service	Finding an outlet to charge electronic product, such as a cell phone or a lap top	GPS
Luggage	Using a restroom	A luggage cart with a security system to use a restroom without bringing the luggage into the restroom
	Handling several pieces of luggage	A luggage cart
	Moving with luggage	
	Moving with luggage with broken wheels	
	Stabilizing the luggage	
	Using hands while moving the luggage	
	Putting luggage on the check-in desk	A product that can help people to move their luggage for check-in
	Measuring the weight of the check-in luggage to follow the luggage regulations	A product that can measure the luggage weight
	Measuring the size of the luggage to follow the luggage regulations	A product that can measure the luggage size

Keyword	Issue	Possible solution
Luggage cart	Finding a luggage cart	A device that shows the location of a luggage cart
	Price	Reducing the price by finding other solutions
	Making changes	A luggage cart check out machine that accepts all types of payment method
	Controlling direction or operation system	Better wheels for easier control
		Automatic system with remote control
	Size	Self size control system
		A luggage cart with two different sizes
	Putting several pieces of luggage onto the luggage cart	A sliding system
		A lower loading base
	Putting heavy luggage onto the cart	A sliding system
		A lower loading base

CHAPTER VI. DESIGN



1. DESIGN PURPOSE

The airport is not only the place providing a transportation service, but also the place people start their travels. The experience at the airport will decide whether they begin their travels in a good mood or they begin their travels with a feeling of restlessness. At the same time, the experience at the airport may determine whether people return home satisfied or dissatisfied and fatigued because of a bad experience at the airport after an otherwise nice trip. Therefore, the airport should be able to offer a better experience than ever before to the people who use it.

The purpose of this study is to research the existing issues at the airport and provide better service for travelers. One of the existing issues is that the existing design of the airport luggage cart, which is intended to help travelers to carry multiple pieces of their luggage, has some issues (see Chapter III for more information). That is why travelers may not use a luggage cart or abandon it. I researched many possible situations at the airport and considered the various functions and designs of the airport luggage cart, looking for potential solutions (see Chapter V for more information). I also observed and analyzed people's behavior for the purpose of designing an airport luggage cart which can better serve many people with a wide range of ages, nationalities, genders, and so on. Moreover, this paper analyzes the current designs of the airport luggage cart from the aspect of Universal Design and suggests a new design under the aspect of Universal Design to provide better service. The new design will make travelers more satisfied and help an airport to serve more people.

2. TARGET USER, THE OUTLIER



Figure 123. Use 01

As previously stated, this study focused on finding ways to solve some issues of an airport. This study chose Universal Design as a way to solve those issues and a luggage cart is one solution for them. As mentioned in the Chapter II, the purpose of Universal Design is to design for all. To design a luggage cart, which shall be easy to use for everyone, it is important to learn about people in a diverse range, instead of learning about people in a specific range. Therefore, this study selected outliers as a target. An outlier is something or someone that deviates from the mainstream in general. This study used a word, outlier, to consider diverse people's needs without alienating the user, so this study learned about the needs or issues of all people, including not only people who usually are included in the target, but also including physically or psychologically challenged people, children, and seniors. A luggage cart that is designed for outliers will not only serve general people, but also will serve better most users.

This section shows several basic needs of some people in a potential user group (see more information about issues and possible solution on Chapter V). First of all, the people with hearing issues mainly have hard time to get information, such as a changing gate number or delayed boarding time, as quickly as others. Thus, they need a way to solve this issue to travel more easily and comfortably. Also, they will have some difficulties to communicate with others at the airport. This communication problem is also related to getting information for most people. The people with hearing issues need a solution, and the solution

Figure 124. Use 02
Figure 125. Use 03



Figure 126. Use 04
Figure 127. Use 05



will make them travel more easily. Moreover, the solution will naturally help almost every other traveler to get information more easily.

The next potential target users are children. An airport will be a very unfamiliar place for children because they do not visit the airport often enough. Moreover, there are so many people in the airport and it is huge, so the children will get easily exhausted, even if they only follow their parents. At the same time, it is not easy for their parents, either.

Travelers on a business trip sometimes have to work in a hurry while they are waiting for their flight. However, finding a place to work at a huge airport is not easy for them because they are not familiar with the place. Moreover, even if they found a place to work, it may be full of people and then they will spend much time on just finding a place.

The airport is not a friendly place for most of people, so they can get tired soon. However, the elders can get even more easily tired than the others do. In general, the elderly people have difficulty to get information at the airport. They may easily miss the announcement that is relevant to their flight schedule. Furthermore, the flight schedule board is usually quickly changed, so it is difficult for them because their eyesight deteriorates with age, as do reaction times. Moving around the airport can make everyone exhausted and it will be more difficult for the elders, especially with their luggage. They can use a luggage cart, but the existing luggage cart is hard to use because of its operating system.



Figure 128. Use 06
Figure 129. Use 07
Figure 130. Use 08
Figure 131. Use 09

People have to push the handle downward to unlock the brake and push it forward at the same time to move the luggage cart. Because of this operating system, the luggage cart requires a certain power and it makes people tired.

The several issues mentioned above are problems not only for certain people. It can be problems for all. The only deviation is that there is a difference of how people feel on those issues, but the existence of problems is a constant force that makes people tired, regardless of age or gender. The importance of this study is to make people more comfortable to use an airport without frustration with simple design.

3. DESIGN PROCESS

This section demonstrates the design process of the final luggage cart design. Most of them focus on having a child seat, changing the size of the luggage cart, putting luggage onto the luggage cart, moving the luggage cart, wheels and information device because these features can solve several existing issues at the airport. The challenging point of the design was deciding how smart the luggage cart could be while keeping it affordable. A luggage cart can be very smart. For instance, it can have a remote control system so that it can drive itself after setting up a destination. However, there are some issues, the technology and the price. The price will rise along with the increasing level of the technology. The initial goal of this study is to offer better service with reasonable price for all. Therefore, this study concentrates on designing simple features that can help users instead of having smart technology in it. At the same time, this study seeks having esthetic sense on a design by considering human factors and flow of force. One of the issues of the existing luggage cart was a design. The luggage cart is practical, but it can accomplish more.

Some of the design considered an automatic system with motor and batteries and controlling a size of the luggage cart (figure 132 to 162). The reason is that some people had hard time moving a luggage cart because of its operating system and the number of pieces of their luggage. They sometimes had too many pieces of luggage on a small luggage cart or too small luggage on a big luggage cart. From the research and the testing, it turns out a size controlling system can offer the size choice, but it can cause other issues. However, an extra part, which can be attached and detached to a luggage cart, can be much more easily used.

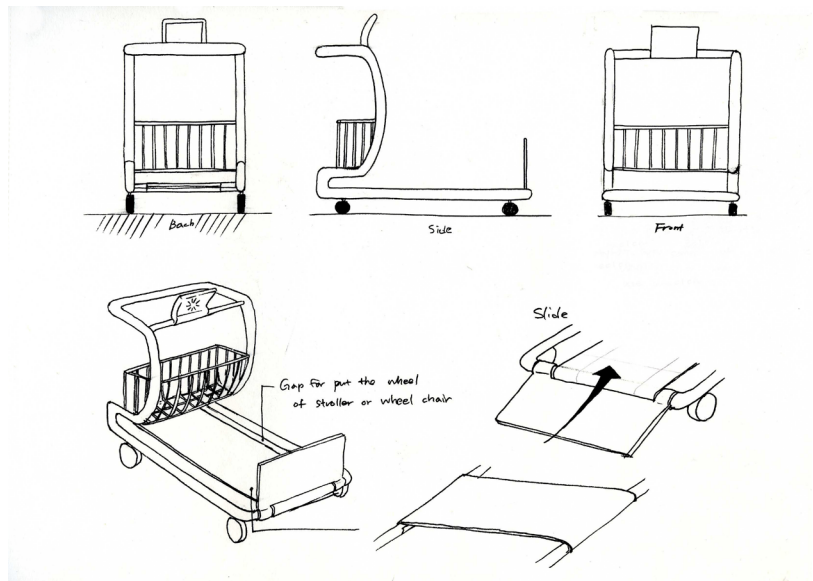


Figure 132. Idea Sketch 01

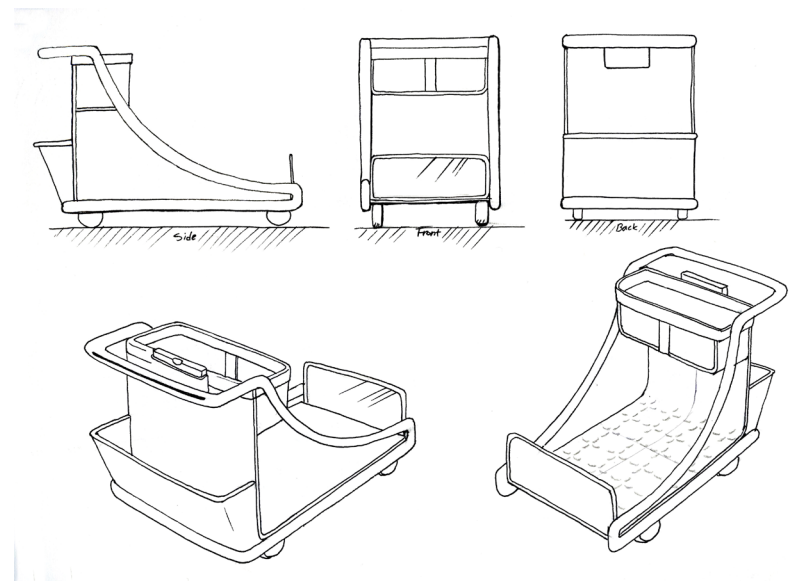


Figure 133. Idea Sketch 02



Figure 134. 3D Modeling Idea Sketch 01



Figure 135. 3D Modeling Idea Sketch 02



Figure 136. 3D Modeling Idea Sketch 03

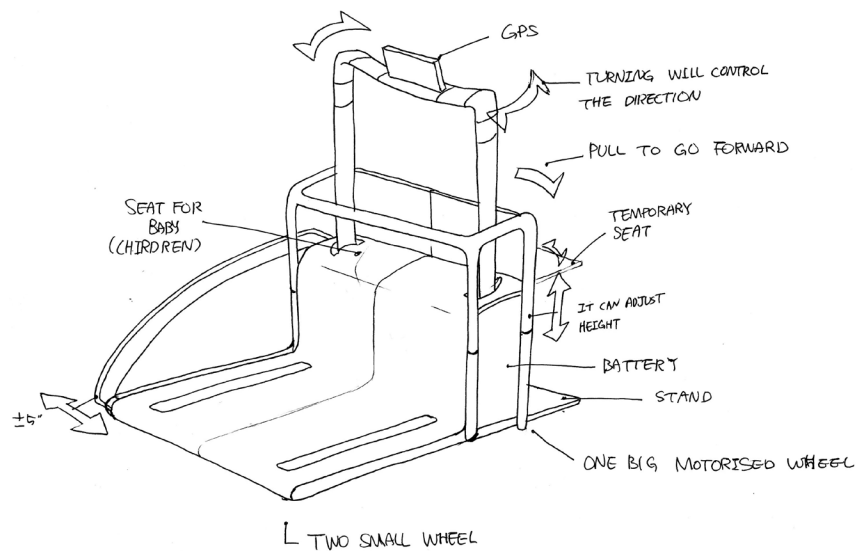


Figure 137. Idea Sketch 03

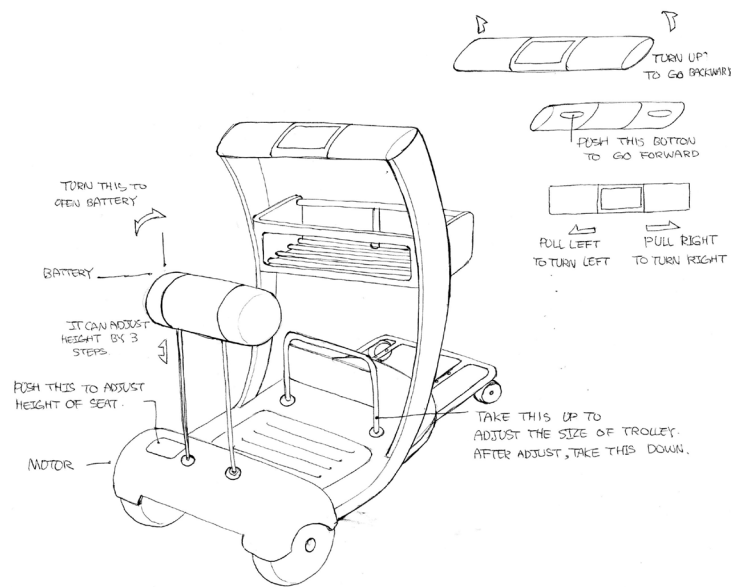


Figure 138. Idea Sketch 04

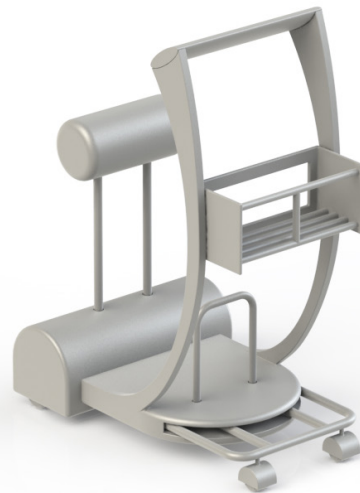


Figure 139. 3D Modeling Idea Sketch 04

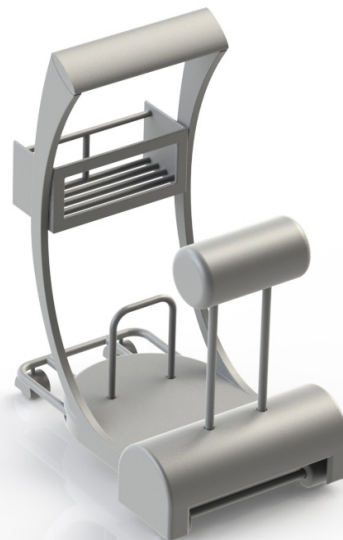


Figure 140. 3D Modeling Idea Sketch 05

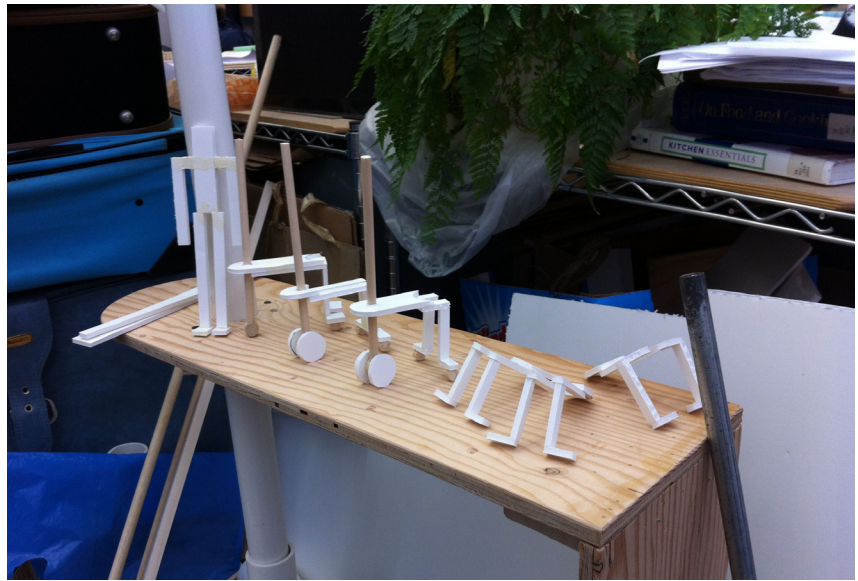


Figure 141. 3D Idea Sketch 01



Figure 142. Mock Up 01 (Left)
Figure 143. Mock Up 02 (Right)



Figure 144. Mock Up 03

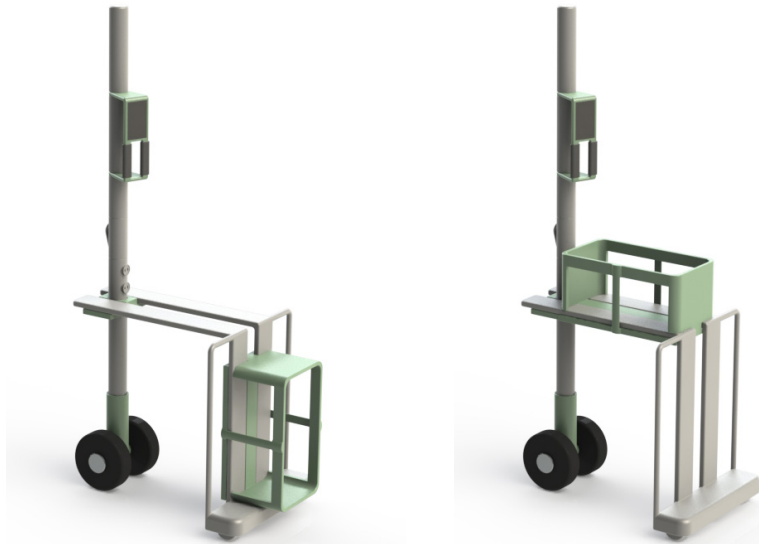


Figure 145. 3D Modeling Idea Sketch 06 (Left)
Figure 146. 3D Modeling Idea Sketch 07 (Right)

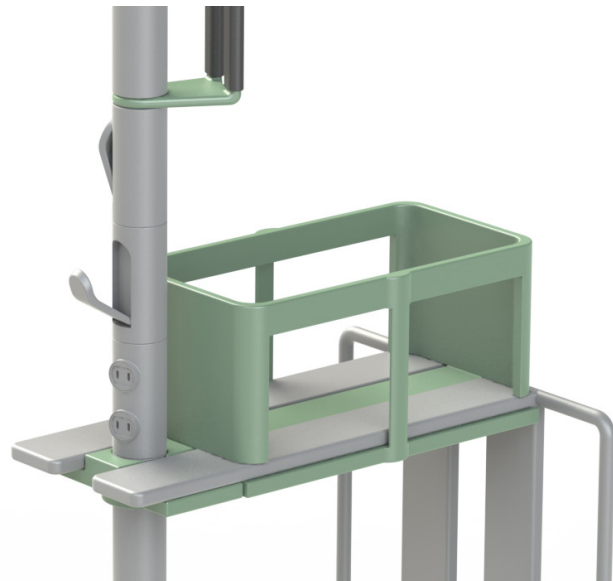


Figure 147. 3D Modeling Idea Sketch 08



Figure 148. 3D Modeling Idea Sketch 09



Figure 149. 3D Modeling Idea Sketch 10

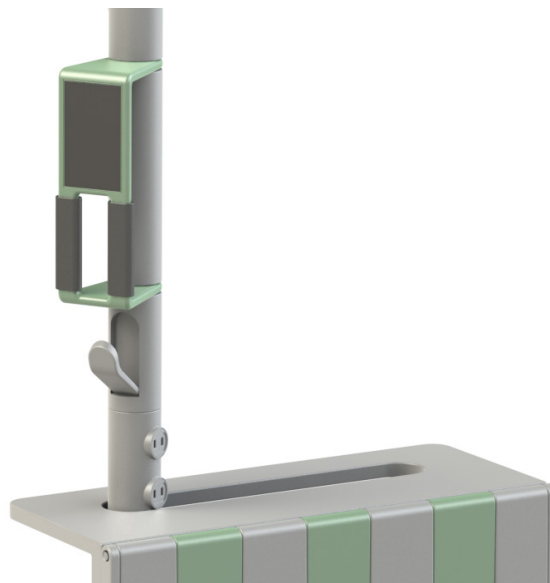


Figure 150. 3D Modeling Idea Sketch 11

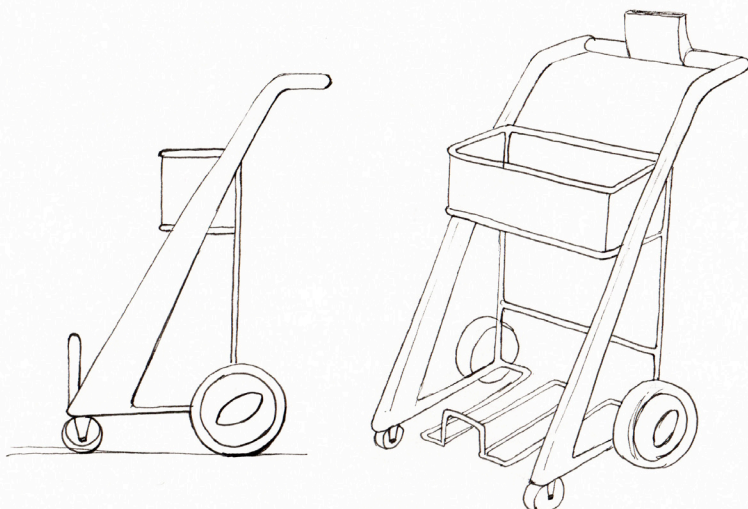


Figure 151. Idea Sketch 05

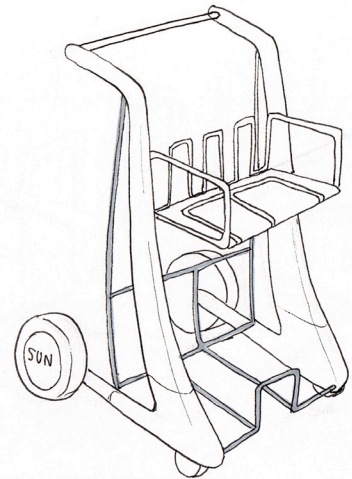
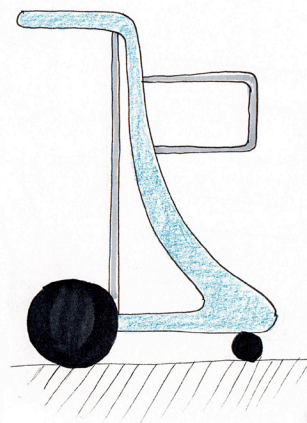


Figure 152. Idea Sketch 06 (Left)
Figure 153. Idea Sketch 07 (Right)

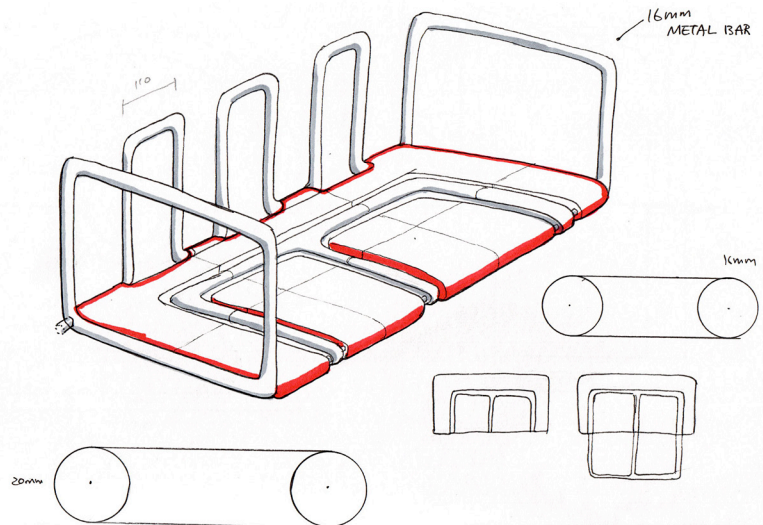


Figure 154. Idea Sketch 08

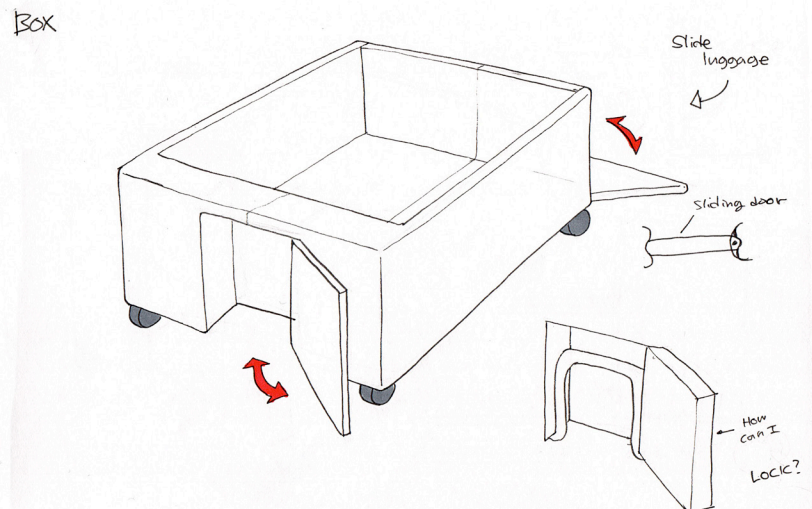


Figure 155. Idea Sketch 09

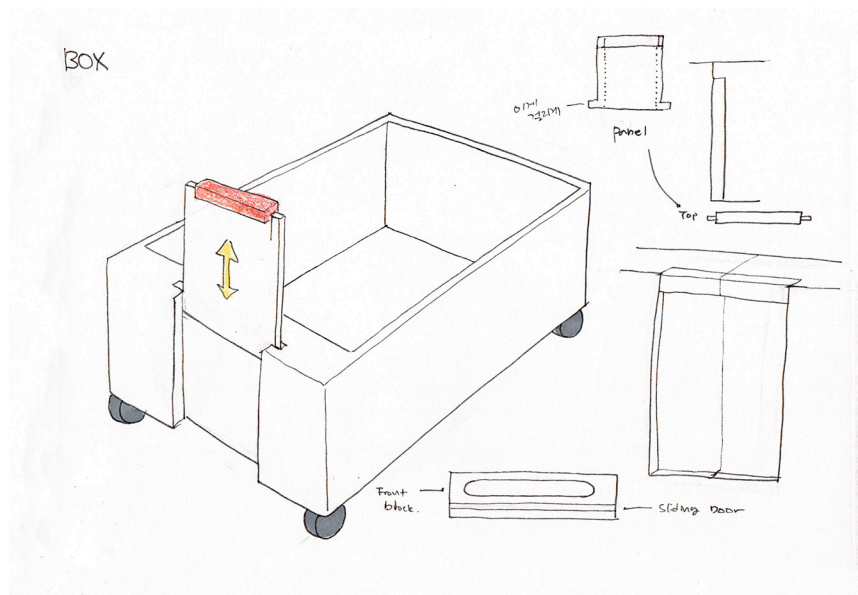


Figure 156. Idea Sketch 10

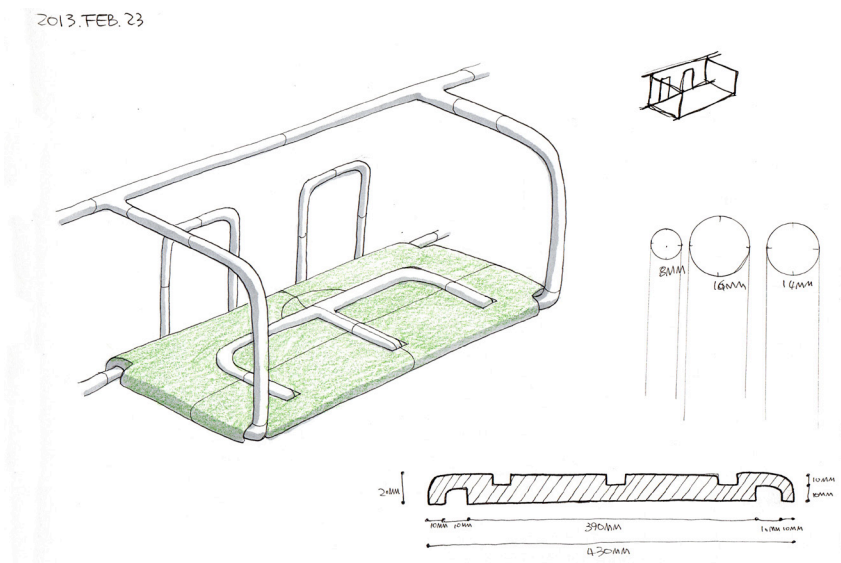


Figure 157. Idea Sketch 11

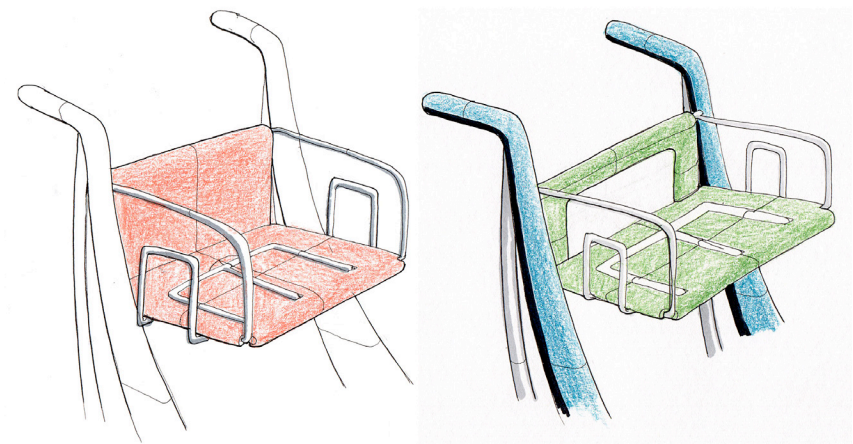


Figure 158. Idea Sketch 12

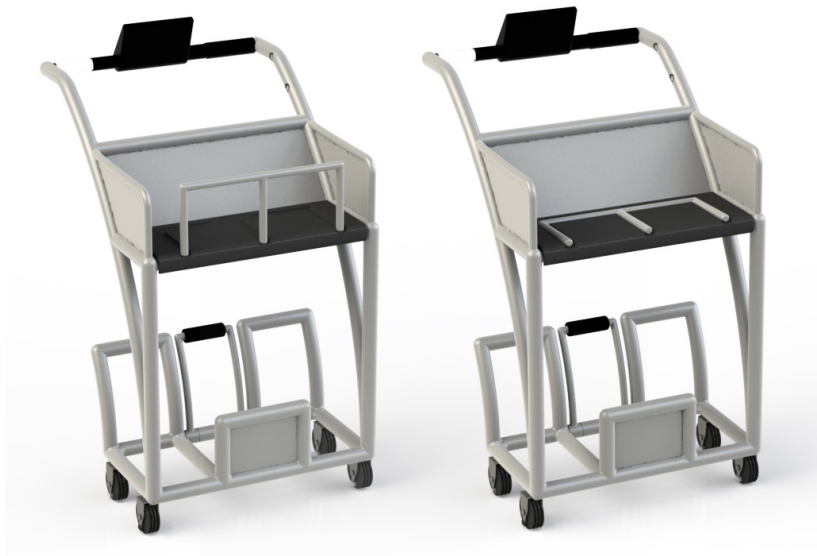


Figure 159. 3D Modeling Idea Sketch 12



Figure 160. 3D Modeling Idea Sketch 13



Figure 161. 3D Modeling Idea Sketch 14 (Left)
Figure 162. 3D Modeling Idea Sketch 15 (Right)

4. FINAL DESIGN

This section shows the final design of a luggage cart. The final design includes three features: a luggage cart, a box and an information device. The following sections show the details of each design and the usage of it. As mentioned on the previous section, Design Process, the final design has an extra part, A Box, which can be attached and detached to the luggage cart depending the user's needs. A box is not a normal box. It has some features to help users to put their luggage on the luggage cart. Also, it will protect the checked-in luggage while it is on the way to the cargo after the user checks in their luggage. The details of each feature are in the following section.



Figure 163. 3D Modeling Final Design 01

4-1. A Luggage Cart, A Cart

A luggage cart is a key design of this study (figure 168). This study chooses a luggage cart as a solution to offer better service for users in the airport because this study realized its potentials through extensive research. To design the luggage cart, this study also researched all the other moving devices, such as a cart in a grocery store, mail cat, trolley, palate truck, stroller, wheelchair, Solo Wheel, etc. Also, the design considered human factors and a luggage regulation of the airlines so that a luggage cart can have a right size for human and for luggage (table 9, figure 165, 166, 167 and 168).



Figure 164. 3D Modeling Final Design 02_Cart

Human Factors : Man

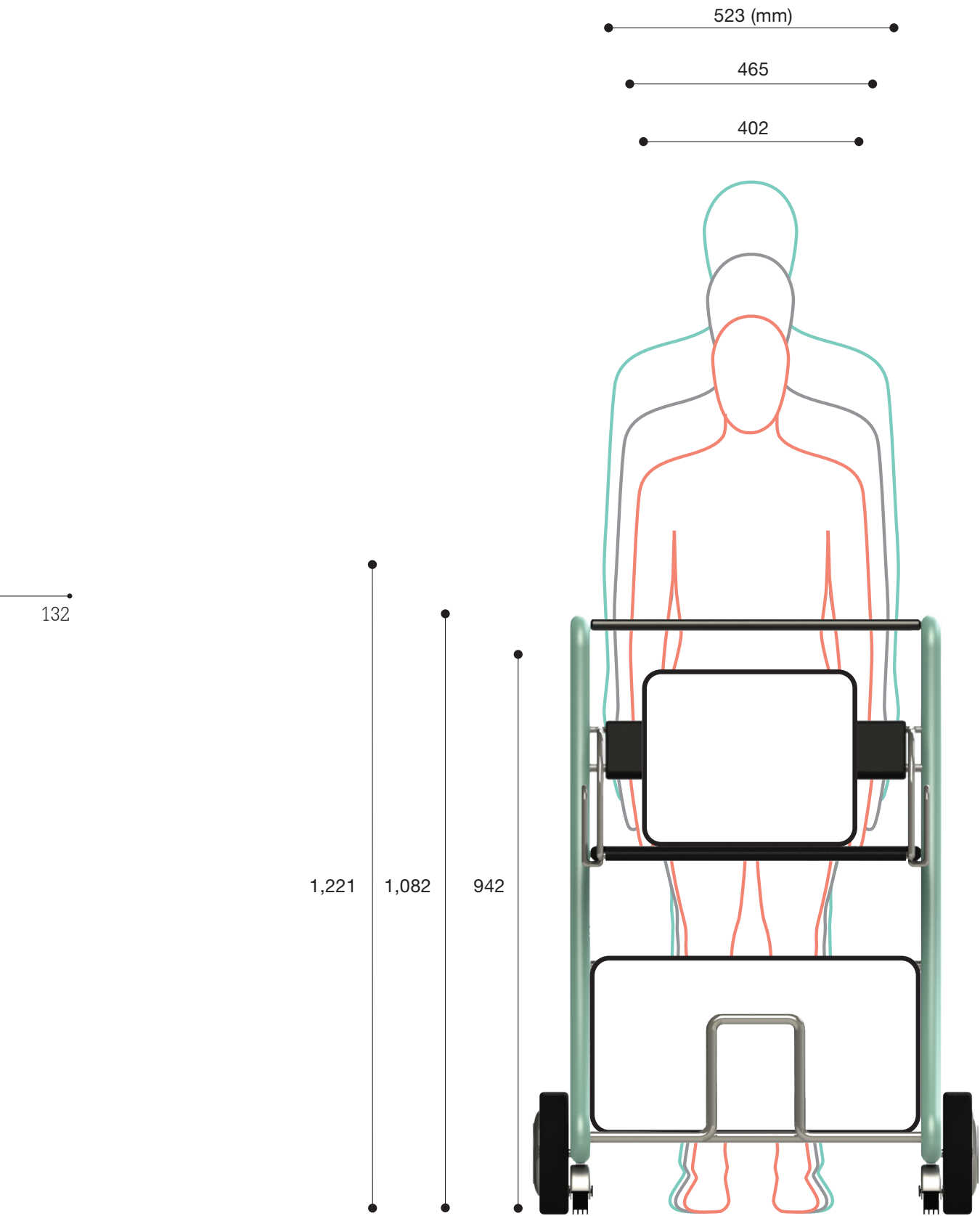


Figure 165. Human Factors_Man Front

DESIGN: FINAL DESIGN: A LUGGAGE CART, A CART

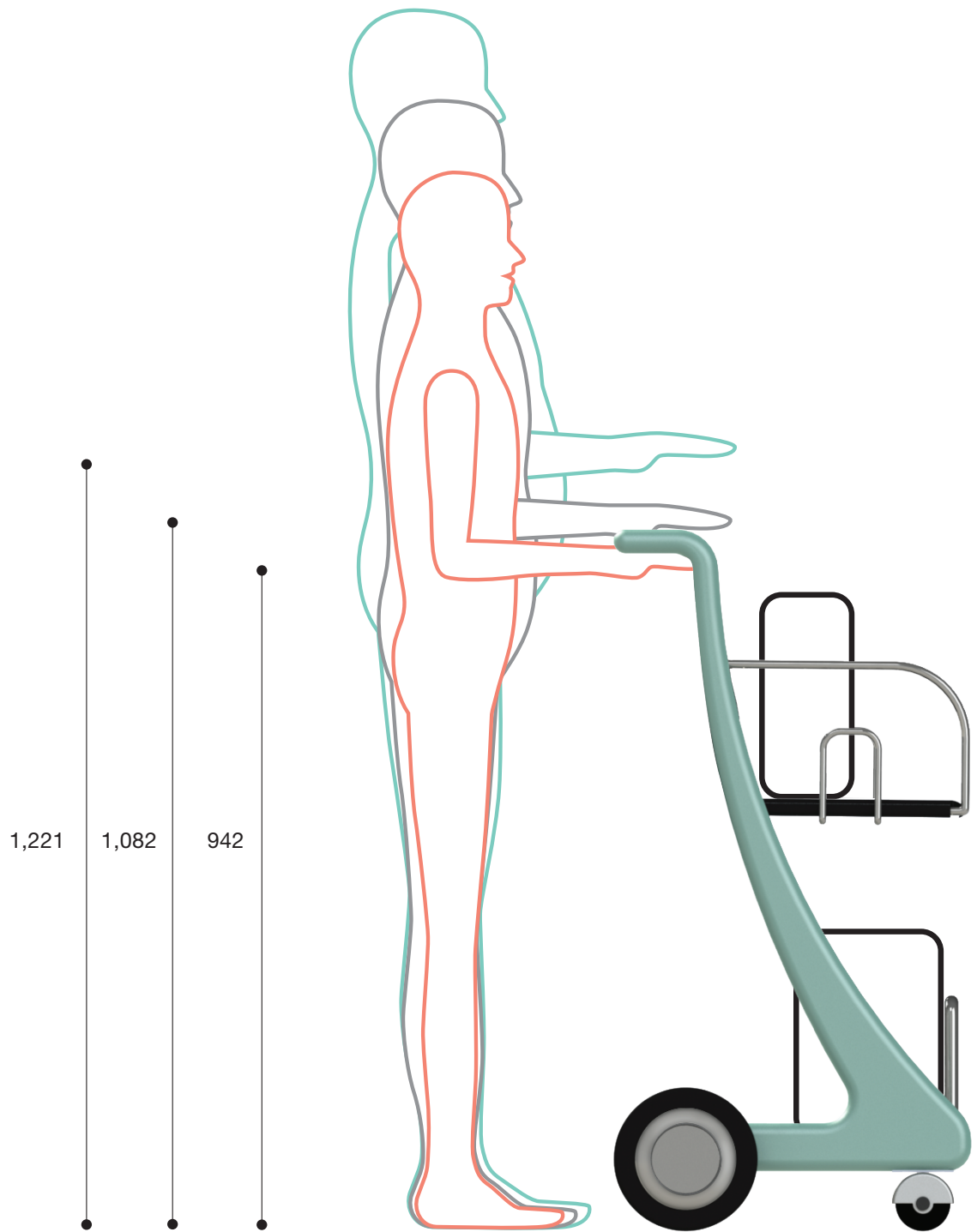


Figure 166. Human Factors_Man Side

— Carry-on Luggage - Overhead Bin : 560 x 350 x 230 - Under the Seat : 460 x 330 x 55

Human Factors : Woman

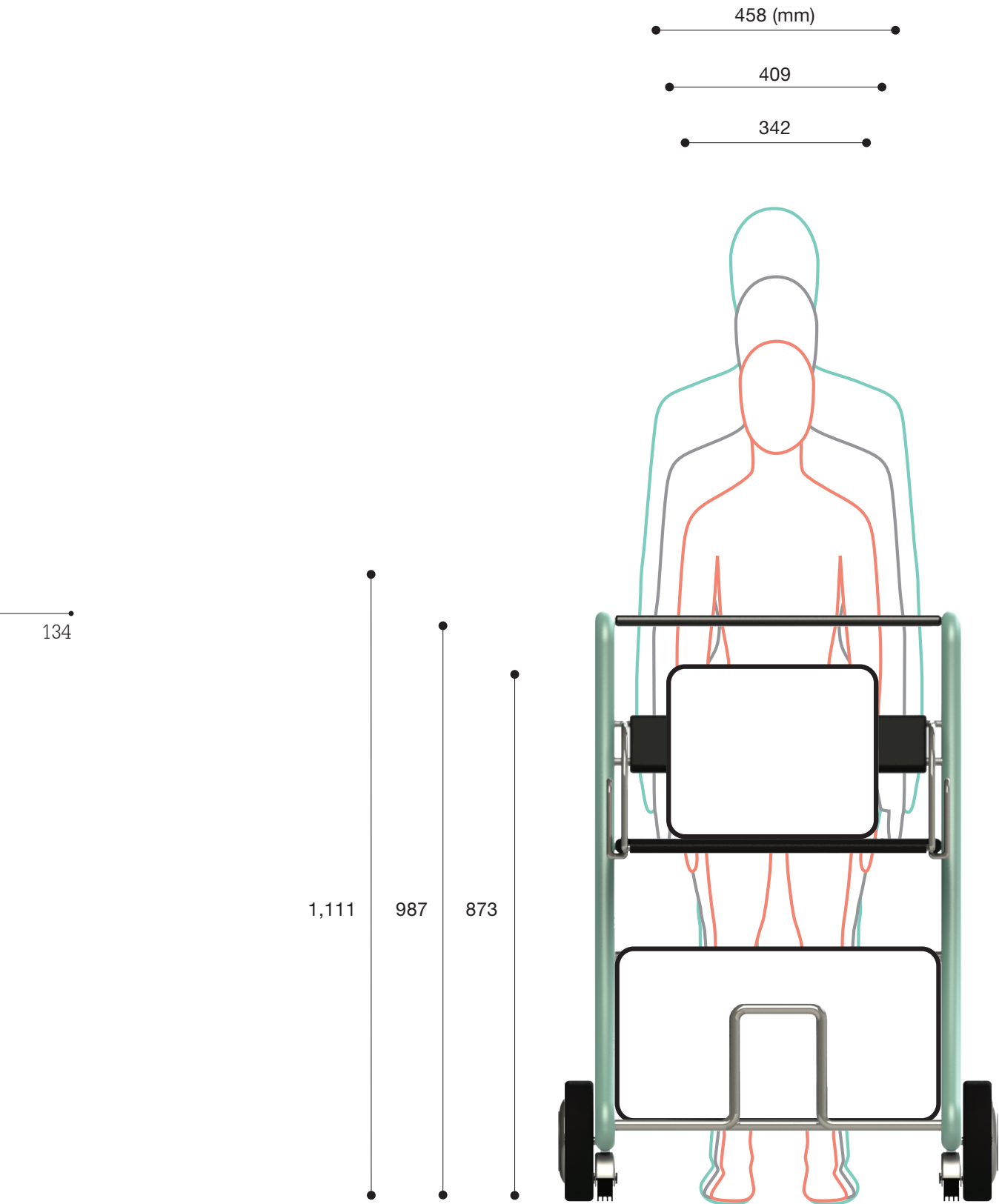


Figure 167. Human Factors_Woman Front

99 Percentile Woman 50 Percentile Woman 1 Percentile Woman

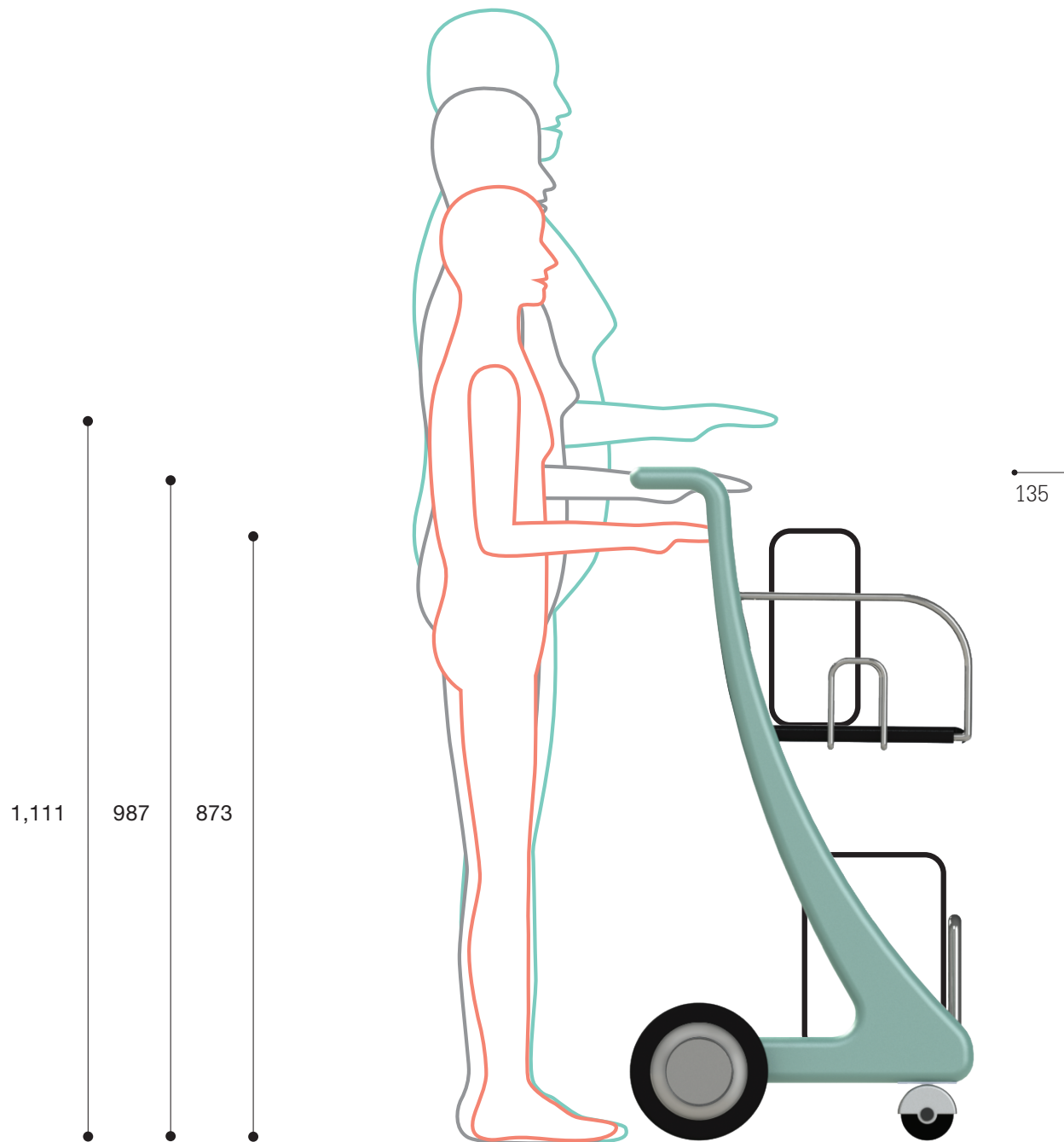


Figure 167. Human Factors_Woman Front

— Carry-on Luggage - Overhead Bin : 560 x 350 x 230 - Under the Seat : 460 x 330 x 55

There are six major characteristics of the final design of the luggage cart. First, the operating system is different with the existing luggage cart. Most of the existing luggage carts have a brake system for the safety reason. The user have to press the handle down to unlock the brake first, and then they can push the cart forward, otherwise the luggage cart will not move. If the user releases the handle, then the brake will automatically activate. So, the user has to press the handle down and push it forward at the same time (figure 169). This operating system designed for the user's safety, but it easily makes them tired because it needs certain amount of force to keep the brake unlocked while they are using the luggage cart. Therefore, this study designed several brake system and test them in a full size model. After the tests, this study selected a rotating brake system (figure 170 and 171). The rotating brake system works when the user rotates the handle. Basically, the handle stays in a locked position. The user will press the handle forward when he/she wants to move the cart, then the handle will naturally rotate and it will unlock the brake (figure 172). This brake system helps the user to spend minimum amount of force to push the luggage cart forward instead of spending force to press down and push forward at the same time.

The second characteristic is a seat. The black plate in the middle is a seat and it has three functions. First, it can be a seat for adult. The height of the seat is higher than the desk chair but it is lower than a bar stool (figure 173). The loading base can be used as a foot rest while a

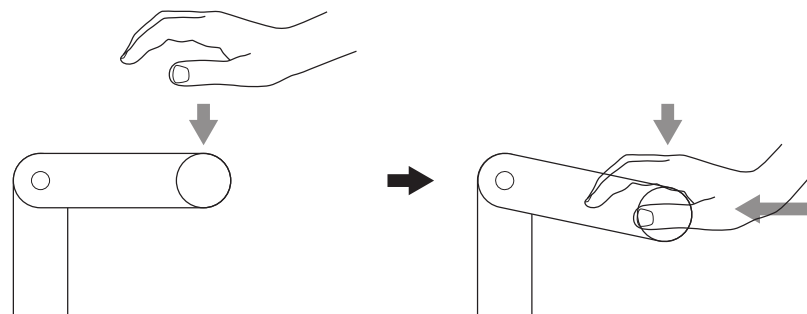


Figure 169. The Brake System of Existing Luggage Cart



Figure 170. The Brake System_Locked Position



Figure 171. The Brake System_Unlocked Position

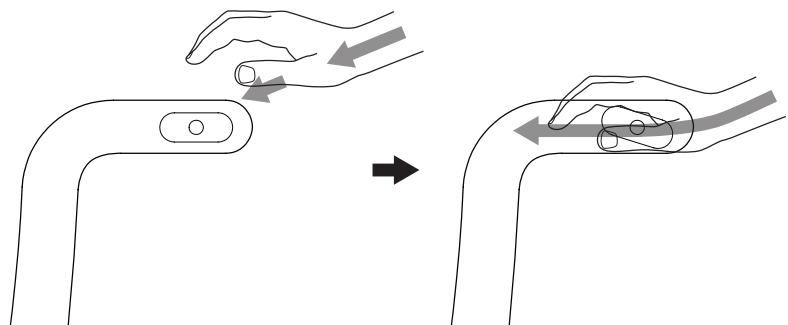


Figure 172. The Brake System of the Final Design of the Luggage Cart

user is fully seated. Furthermore, if a user travels with a child, then he/she can use the seat as a child seat by using the safety bar on the seat (figure 174). The safety bar operates with a very simple system. There is an indent on the seat so that a user can hide a safety bar when he/she sits on the luggage cart. If the user wants to use the safety bar, then he/she can rotate it up. Once the safety bar is up, the user can fix the position by pressing it down. The seat has a safety bar-shaped indent and there is a deeper indent at the end to fix the safety bar on upright position (figure 174). Plus, the user can put his/her small bags on the seat and use the safety bar to block his/her belongings to prevent them from falling down to the floor.



Figure 173. A User on the Seat



Figure 174. The Safety Bar of the Final Design of the Luggage Cart

The third characteristic is hooks (figure 175). The hooks are located on both the left and right side of the luggage cart. It is designed for the users to hang their small bags. Sometimes, the small bags can fall down when the user puts them on the cart because it may be too small for the cart, then the user can hang it on a hook. The hooks are useful especially at the international airport that has duty free stores. The users may buy some gift for their friends, and then they will have several small bags to hang on the hooks.

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The next characteristic is a loading base on the final design of the luggage cart. The user does not need much space after checking-in because the user will only bring a carry-on or personal item inside of



Figure 175. The Hooks of the Final Design of the Luggage Cart

the security checkpoint. The user can also check their carry-on luggage size with the loading base on the luggage cart whether his/her luggage is allowed to carry on the flight or not. The loading base can be used not only as a place to put a carry-on, but also as a foot rest while the user sits on the seat.

The fifth characteristic is a front block. A front block is located on the loading base. It is designed to prevent luggage from falling down to the floor. However, the front block has another interesting function. It connects with another additional part, A Box (see next section for more information). According to the research, this study decided to design a luggage cart in a minimum size and design an additional part, a box, which can be attached and detached from the luggage cart. The additional part, A Box, was designed by considering the maximum size regulation of a piece of carry-on luggage (table 9). The user can put the check-in luggage on A Box and attach it to the luggage cart to move all together. When the user checks-in, he/she can detach A Box from the luggage cart and give it to a flight attendant (see next section for more information).

The last characteristic is a design of the luggage cart. This study considered the flow of force. This is strongly related to the handle operating system. As mentioned before, the existing luggage cart needs quite a big amount of force to move. Hence, this study learned the flow of force to design a luggage cart that can be moved with only minimum force (figure 176). At the same time, this study considered aesthetic points of the luggage cart so that the user can feel stylish while using a luggage cart. Also, the final design gets rid of any unnecessary parts of the luggage cart to have a simple design. The unnecessary parts of the luggage cart only make users confused, so the users may think that the luggage cart is difficult to use. Also, the wheel size of the final design differs from the existing wheel size of the luggage cart. The bigger wheels can handle more weight with less power.



Figure 176. The Flow of Force on the Final Design of the Luggage Cart

4-2. A Check-in Box, A Box

A user can put a carry-on on the loading base, hang several bags on the hooks on the luggage cart, and use an extra part, A Box, to move multiple pieces of check-in luggage (figure 177). A Box has a connecting system, so the user can easily attach it to the luggage cart. When the user checks in, he/she can give A Box to the flight attendant with his/her luggage in it. The flight attendant can use A Box to carry checked-in luggage to move it to the cargo. Then, he/she can use a small luggage cart to move the rest of his/her belongings instead of using a big luggage cart because he/she does not need to use a big luggage cart anymore after checking-in his/her luggage.

A Box helps not only the user to move check-in luggage, but it also helps the user to load his/her luggage on A Box. A Box has a hinged door (figure 178). The user has to lift the notched lip to open the hinged door, and then rotate the hinged door down to the floor. After that, the user can slide his/her luggage into the box (figure 179).

The research on the previous chapter shows the people had trouble stacking up the luggage. They have to lift the luggage up to put it on the luggage cart. Sometimes, the user even has to lift the luggage all the way up to stack it up on another piece of luggage. This study did some tests with several solutions for it (see Section 3 of Chapter VII for examples). First one was a luggage cart with a lower loading base. This idea has two basic issues. One of the issues was that the user still has to lift the luggage up and the other issue was the size of the wheels.

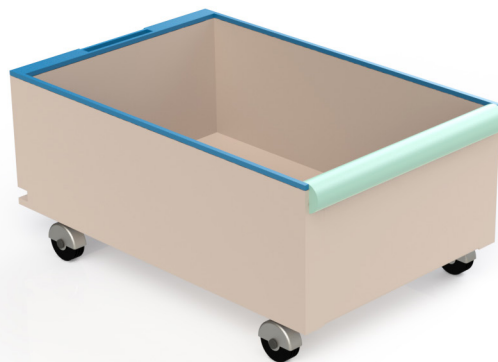


Figure 177. 3D Modeling Final Design 03_Box

The size of the wheels was restricted to having a lower loading base. However, it is better to have big wheels instead of having small wheels because the user can move the luggage cart more easily with less force when they use big wheels.

The second idea was a part that can hold all pieces of luggage together and pull all at the same time. Then, the user will use the wheels on the luggage cart itself to move it. The advantage of this design is it can be very simple and small. The user can even carry it with them instead of finding a luggage cart at the airport. However, the problems are that some of the luggage may have wheels in bad condition or may not have wheels. Moreover, some luggage may not be able to be pulled in a proper way because of the stability of the luggage.

The hinged door idea came up after these tests. The biggest challenge of designing a box was also designing a system to help a user to put the luggage on the box without any difficulties. This study tested some solutions such as a lower base, automatic system, sliding system, etc. In conclusion, the hinged door was the best solution.

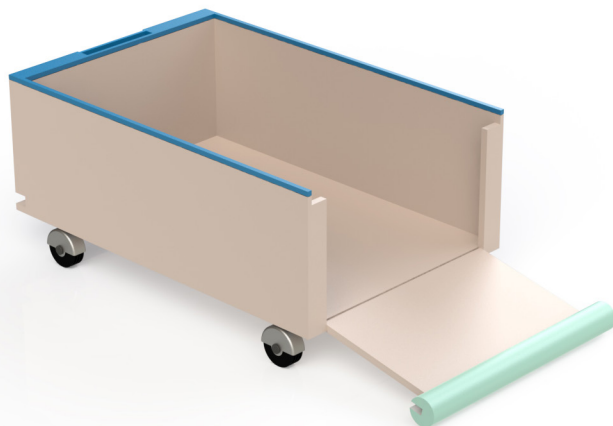


Figure 178. 3D Modeling Final Design 04_Box_
Hinged Door



Figure 179. A Box_Hinged Door Usage

DESIGN: FINAL DESIGN: A CHECK-IN BOX : A BOX



As this study mentioned before, A Box is an additional part that can be attached and detached from the luggage cart. After coming up with the idea of having an extra part to move several pieces of check-in luggage, this study continued considering the easiest way to attach A Box to the luggage cart. The sliding latch was selected as the best solution. Otherwise, a box would need a complicated part or the user has to lift up the box to connect it to the luggage cart and both are difficult to use. The user can slide the latch up and push the luggage cart to the space inside of the latch. After fitting the front block into the space inside of the latch, the user can close the latch, and then the box is secure with a luggage cart (figure 180).

Also, the worker at the airport can stack up all the boxes together when they store it or even when the luggage is on it. Then, the luggage will be safe inside of the box and the users do not have to worry about their luggage being damaged by other luggage.



Figure 180. A Sliding Latch Usage



4-3. An Information Device : A GPS



Figure 181. 3D Modeling Final Design 05_A
GPS

The last part of the final design is an information device. The information device, A GPS, will solve several issues at the airport. Two of the major issues at the airport are communication and getting information. The information device can solve not only several small issues at the airport but also these two major issues. The user can rent an information device, A GPS, from a vending machine. He/she can check-in with A GPS. If he/she does not have check-in luggage, then he/she can go directly to the security check. After going through the security checkpoint, the user can use several features of the information device. The reason why this study designed an information device as a separated part not attached to the luggage cart is that the information device can be offered to the user who does not use a luggage cart, if it is designed as a separated part.

The information device designed in a clip style (figure 182). It means it can be attached on the handle of the luggage cart or any other place such as a handle of the user's luggage or a handle of a stroller (figure 183). The inside of the holding part of the GPS is filled with Memory Foam. The Memory Foam will prevent slips when it is attached to something. The LED lighting is located on the top of the GPS. It will light up when it has new information for the user or when the boarding time is up.

The information device, A GPS, has four major functions. First of all, the user can check-in with A GPS. When the user arrives at the airport,



Figure 182. 3D Modeling Final Design 06_A
GPS Clip System



Figure 182. 3D Modeling Final Design 06_
A GPS Clip System

he/she has two options to check-in. One way is going to the check-in desk. In this case, the user can talk with a flight attendant about their concerns. However, the user may have to wait for a long time or the user may have hard time finding a right check-in desk because every airline has its own check-in desk. The other option to check-in is renting an information device from a vending machine. If the user rents an information device, A GPS, from a vending machine, then the user can use it as a ticket, a GPS, or an information device. If the user does not have luggage to check-in, then they can head directly to the security checkpoint. When the user has several pieces of luggage to check-in, he/she can still rent an information device. In this case, the user can check-in through the device by following every step including

information of his/her check-in luggage. Then, the device will let the user know the way to go to the right check-in desk and they can go to the self checked-in desk to give their check-in luggage. They do not have to go through the check-in process again, they can just give their check-in luggage to the desk and get a luggage ticket.

The second major function of the information device is a GPS. Many people at the airport have some difficulties finding their ways to go to the specific place or even some people have trouble finding out what kind of place they can go while they wait for their flight. The problem becomes more serious at the huge international airports. The information device, A GPS, will show the entire place the user can go and will show the way to get there. Thus, if the user rents the information device, then the users do not have to worry about losing their way or do not have to spend much time wandering around at the airport.

The third major function of the information device is an Alarm. The information device has the user's flight information including boarding time, gate number, etc. Because he/she checked-in with it. So, the device will alarm by flickering the LED light when the flight schedule is changed or when the airline is looking for the user. Sometime, the airlines announce that they are looking for a passenger but it is hard to hear the announcement at the huge airport because of the all the surrounding noise. However, the airlines will know who checked-in, then they can send a message to the user's device and announce at the same time to find a passenger more quickly. Also, people may fall asleep while waiting for the boarding time or may forget to check the time. The user does not have to worry about missing their flight anymore because A GPS will flicker its LED light to let the user know when the boarding time is up. If the user is sleeping, then the person next to the user who sees the light can help the user wake up. The most important part of the alarming system is that the user does not have to keep his/her eye on his/her flight schedule because the device will let the user know if the flight schedule is changed. Even if the user has a hearing issue, they can still use the information device well because it will flicker the light when it has updated information.



Figure 184. 3D Modeling Final Design 06_A
GPS LED Lighting

Lastly, the user can get all the information about his/her flight, an airport or his/her destination from the information device. Finding a person to ask something at a huge airport is not easy. If the users use an information device, A GPS, then they can find almost all information from the device. Even the user can contact security with A GPS if he/she is in danger.

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The four functions mentioned above are the major functions of A GPS. This can solve many issues that were found by the previous research (see Chapter V for more information). This is a new way to check-in and people may not be used to operating this method at first. However, it will make people's lives much easier when they can fully grasp the concept of it. Also, a lot of people are already used to a smart phone. Thus, they can be easily adapted to use A GPS. The user has to give A GPS to the flight attendant when they board on a flight because it is regarded as a boarding ticket.

5. FINAL DESIGN IN USE



Figure 185. Final Design in Use 01

DESIGN: FINAL DESIGN: FINAL DESIGN IN USE



Figure 186. Final Design in Use 02

Figure 187. Final Design in Use 03



Figure 188. Final Design in Use 04



Figure 189. Final Design in Use 05



Figure 190. Final Design in Use 06



Figure 191. Final Design in Use 07

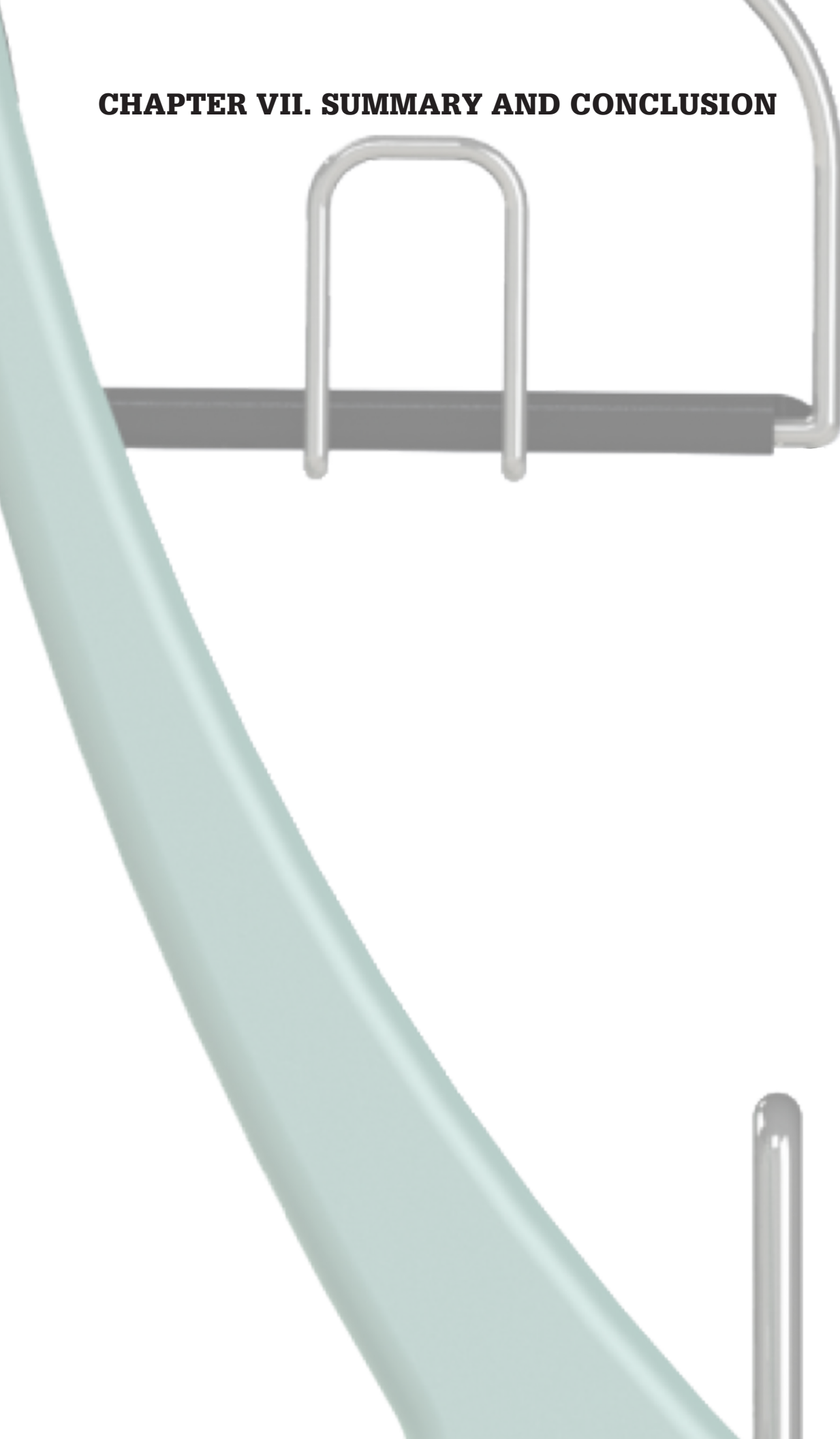


Figure 192. Final Design in Use 08



Figure 193. Final Design in Use 09

CHAPTER VII. SUMMARY AND CONCLUSION



1. SUMMARY OF MAJOR FINDINGS

This study was started from personal experience, and the research discovered many issues at the airport. This study conducts three different methods of research to find issues at the airport and the users' needs: making up hypothetical scenarios, conducting observations, and doing a survey with a simple interview. The realized issues can be categorized under three major topics, which are moving luggage, getting information, and communicating with people. Some of the issues founded from research can be easily solved with a simple design. This study found the potential of the luggage cart while doing a research. Therefore, the luggage cart was selected as a method to solve the issues and this study has chosen the concept of the Universal Design as a way to approach to the final design of the luggage cart. Therefore, this study also includes some examples of the Universal Design to study about Universal Design. The main purpose of this study was designing a luggage cart that can help as many users as possible without exclusion with a practical design.

2. CONCLUSIONS

Many different people use an airport to take a flight. However, many of them have some issues to use an existing luggage cart. Thus, this study decided to design a luggage cart from the view of Universal Design, which is a design theory to design for all. The airport can be a better service area and people do not have to have hard time staying at the airport anymore with this final design: A Cart, A Box, and A GPS. This study had some difficulties in conducting a research such as observing at the several different airports, and doing some interviews with people who work at the airport because of the security reason. This study would be more strongly supported with more extensive research and findings. Also, testing the final design at the airport with different people, the potential users, will prove the importance of this study. The major issues at the airport are moving luggage, getting information, and communicating with people. A luggage cart can even represent an airport by offering better service with simple design. The final design can solve many issues that were found from the research. By instituting this final design in the airport, the users no longer have to struggle with their luggage while moving, spend much time in finding a place, or have hard time communicating with people to get necessary information anymore.

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